समाचार पत्रिका

नेपाल भौगर्भिक समाज

Volume 23

April 2006 (बैशाख २०६३)

NEWS BULLETIN OF NEPAL GEOLOGICAL SOCIETY

NEPAL GEOLOGICAL SOCIETY

(EST. 1980)

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Giving Impetus to

NEPAL'S Hydropower Development

With the objective of developing Nepal's hydropower resources as a foundation for the nation's development, Butwal Power Company (BPC) since its establishment way back in 1966 has always remain committed to its aim and vision. The company with an affluent experience of over three and half decades and in its pursuit has provided outstanding services to the nation and in the route has given tremendous results to some of the hydropower project works of the country.

BPC owns and operates 12 MW Jhimruk Power Plant and 5.1 MW Andhikhola Power Plant and distributes electricity to over 23,000 consumers and sells energy to Nepal Electricity Authority. BPC also owns 14.9% shares in Himal Power Limited, the company which owns Khimti 60 MW Hydropower Plant, one of the biggest hydropower projects of the country in private sector. BPC is also 51% share holder in Nepal Hydro & Electric Pvt. Ltd., which deals with electro-mechanical works of power projects.

After the privatization of BPC, the company with much more concentrated maneuver is cruising further. The Khudi project is the reflection of company's ambition to expand both its distribution and generation activities to its consumers. Apart from the other miscellaneous hydropower services, the company also offers high-standard consultancy services as a consultant in Hydropower, Engineering, Community & Environment and Project Management.

CRAYONS/BPC/04

Engineering:

Site investigation, project planning
Feasibility studies and detailed engineering design
Hydrological and mathematical modeling
Design audit and review
Economic and financial analysis
Geotechnical and geological investigation

Community & Environment:

Environmental Investigations (EIA, IEE etc.)
Preparation of Environmental Mitigation and Monitoring Plans and their implementation
Socioeconomic studies and enterprise development.

Project Management:

Project planning, evaluation, management, implementation, tendering and procurement.
Construction management and supervision
Project rehabilitation

ISO 9001 & ISO 14001 REGISTERED

In the service of nation

Butwal Power Company Ltd.

Hydropower Developers & Consulting Engineers

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Editorial

We are pleased to release this 23rd volume of News Bulletin and express our best wishes to all the members and well-wishers of the Nepal Geological Society. Apart from the information on the activities of the Nepal Geological Society, this News Bulletin also contains a few popular and scientific articles on various topics of natural hazards. There is also a list of recently published books in Nepal on engineering geology and environmental geology.

We thank all the authors for contributing their papers to this News Bulletin. We appreciate the constant support and co-operation extended by the members of Nepal Geological Society during the preparation and publication of this News Bulletin, other journals, and brochures. We are also grateful to the consulting firms, agencies, and organisations that provided with technical and financial support to the Nepal Geological Society. Mr Pradeep Paudyal and Miss Anu Shrestha are thanked for making layout and redrawing several figures.

Thank you.

–Editors

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LIST OF PUBLISHED JOURNAL OF NEPAL GEOLOGICAL SOCIETY

S.N.	Description	Cost (NRs)
1.	Journal of Nepal Geological Society (Abstracts of Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation, 28–30 September 2005), Vol. 32 (Special Issue), September 2005	500.00
2.	Journal of Nepal Geological Society, Vol. 31, June 2005	500.00
3.	Journal of Nepal Geological Society (Proceedings of Fourth Nepal Geological Congress, 9–11 April 2004), Vol. 30 (Special Issue), December 2004	500.00
4.	Journal of Nepal Geological Society, Vol. 29, June 2004	500.00
5.	Journal of Nepal Geological Society, Vol. 28, June 2003	500.00
6.	Journal of Nepal Geological Society (Proceedings of Third Nepal Geological Congress, 26–28 September 2001, Kathmandu, Nepal), Vol. 27 (Special Issue), September 2002	500.00
7.	Journal of Nepal Geological Society, Vol. 26, June 2002	500.00
8.	Journal of Nepal Geological Society (Proceedings of Workshop on the Himalayan Uplift and Palaeoclimatic Changes in Central Nepal, 10 November 2000), Vol. 25 (Special Issue), December 2001	500.00
9.	Journal of Nepal Geological Society (Abstract Volume of Third Nepal Geological Congress, 26–28 September 2001), Vol. 24 (Special Issue), September 2001,	300.00
10.	Journal of Nepal Geological Society, Vol. 23, June 2001	300.00
11.	Journal of Nepal Geological Society (Proceedings of International Symposium on Engineering Geology, Hydrogeology, and Natural Disaster with Emphasis on Asia, 28–30 September 1999, Kathmandu, Nepal), Vol. 22 (Special Issue), December 2000,	1000.00
12.	Journal of Nepal Geological Society, Vol. 21, June 2000	300.00
13.	Journal of Nepal Geological Society (Abstract Volume of International Symposium on Engineering Geology, Hydrogeology, and Natural Disaster with Emphasis on Asia, 28–30 September 1999, Kathmandu, Nepal), Vol. 20 (Special Issue), 1999	500.00
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21.	Journal of Nepal Geological Society (Abstract Volume of First Nepal Geological Congress, 1995), Vol. 12 (Special Issue), 1995	300.00
22.	Journal of Nepal Geological Society (Proceedings of 9th Himalaya–Karakoram–Tibet Workshop, 1994), Vol. 11 (Special Issue), 1995	300.00
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28.	Journal of Nepal Geological Society, Vol. 7 (Special Issue), 1991	300.00
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30.	Journal of Nepal Geological Society, Vol. 5, No. 1, 1988	300.00
31.	Journal of Nepal Geological Society, Vol. 4 No. 1 & 2, 1987	300.00

32. Journal of Nepal Geological Society, Vol. 4 (Special Issue), 1984* 300.00
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37. Journals of Nepal Geological Society, Vol. 1, No. 2, 1981* 300.00
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CONTENTS

NGS News

The 26th General Body Meeting-2062 B. S. of the Nepal Geological Society was held in the Auditorium Hall of the Department of Mines and Geology, Lainchaur, Kathmandu, on 2 September 2005. The chairman of the meeting, Dr Ramesh Man Tuladhar, President of the Nepal Geological Society, welcomed the participating members. Mr. Lila Nath Rimal, General Secretary of the Society, presented a report on the programmes held during the last year and informed the participants about the programmes to be held in the fiscal year 2062–63. He also presented the agenda of meeting and informed about the Fifth Asian Regional Conference to be held on 28–30 September 2005 in Kathmandu. The Treasurer of Society, Mr. Jay Raj Ghimire, presented the annual financial report of the fiscal year 2062–63.

The **N**epal Geological Society organised a talk programme on 2 September 2005 in the Auditorium Hall of the Department of Mines and Geology, Lainchaur, Kathmandu. In that talk programme, Dr Megh Raj Dhital presented a scientific paper entitled "Lesser Himalayan Tertiary Beds in west Nepal and their extension in Kumaun Himalaya, India".

The Nepal Geological Society organised the **Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation** on 28–30 September 2005 in collaboration with the International Association for Engineering Geology and the Environment (IAEG), and Asian Regional Groups of IAEG in Kathmandu, Nepal. The symposium was attended by 209 geoscientists from 22 countries and they presented 73 technical papers. After the three-day long symposium, two field excursions were organised. A four-day excursion was conducted in west Nepal (i.e. Kathmandu–Pokhara–Baglung–Kathmandu) and a one-day excursion was organised on the Kathmandu–Kodari–Kathmandu route. These excursions were attended by 18 and 11 participants, respectively. The conference was inaugurated by Professor Dr Govind Prasad Sharma, Honourable Vice Chancellor, Tribhuvan University. Dr Ramesh Man Tuladhar, President of the Nepal Geological Society, welcomed the participants in the conference. Dr R. P. Bashyal, Convener of the Fifth Asian Regional Conference, shed light on the status of the conference. He also pointed out that such an august gathering of geoscientists from the region in Nepal can prove to be an excellent forum for interaction among themselves as well as with their counterparts from the developed countries. The General Secretary of the Nepal Geological Society, Mr L. N. Rimal, gave the vote of thanks. Dr Niek Rengers, President of the IAEG, sent an email message to the conference, which was read out by the Convener. In his message, he thanked the organisers for their effort and highlighted the importance and relevance of such a conference in the Asian region. He mentioned that a Federation of International Geo-engineering Societies (FIGS) was formed and a new communication system with its website and e-Bulletin was developed for the IAEG members.

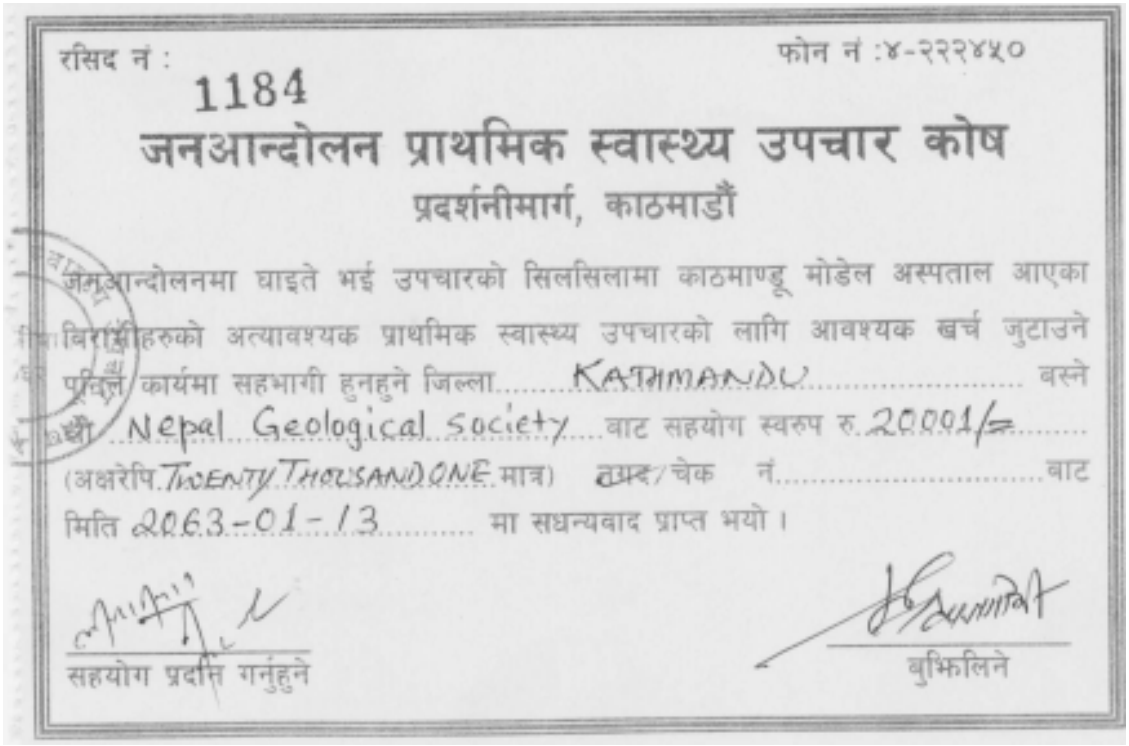
On the occasion of International Strategy for Disaster Reduction (ISDR)-Day 2005, the Nepal Geological Society in collaboration with the Society for Resource Conservation organised a one-day workshop on 19 October 2005 on the theme 'Increasing Disaster Resilience using Micro-finance and Safety Nets' announced by UN/ISDR. The ISDR-Day scheduled to be observed on every second Wednesday of October was postponed for third Wednesday of the month due to the Vijaya Dashami, the greatest Hindu festival. The workshop was participated by more than 50 geologists and several intellectuals working in financial and other multidisciplinary sectors. The workshop was convened by Dr Ramesh Man Tuladhar, President of the Nepal Geological Society.

As in the past, the Nepal Geological Society celebrated the Earthquake Safety Day-2062 by participating in the three-day long Earthquake Safety Exhibition-2062 held at Bhaktapur Durbar Square, Bhaktapur. On this occasion, a number of awareness-raising posters and pamphlets were displayed. Several thousand visitors, including the second vice chairman of the council of ministers, attended the stall.

NGS News

नेपाल भौगर्भिक समाजका आजीवन सदस्य तथा केन्द्रीय भू-गर्भ विभाग, त्रिभुवन विश्वविद्यालयका उप-प्राध्यापक डा. प्रमोद कुमार ठाकुर को मिति वि.सं. २०६२ चैत्र २५ गते र अर्का आजीवन सदस्य डा. गुडरुन कोर्भिनसको मिति सन् २००६ जनवरी १ तारिखका दिन असामयिक स्वर्गारोहण भएकोमा नेपाल भौगर्भिक समाजले मिति २०६३ बैशाख ६ गतेका दिन खानी तथा भू-गर्भ विभाग, लैनचौरको ओडिटोरियम हलमा एक श्रद्धाञ्जली कार्यक्रमको आयोजना गरेको थियो । उक्त कार्यक्रममा विभिन्न वक्ताहरुले दिवङ्गत आत्माहरुको चिर शान्तिको कामना गर्दै भौगर्भिक क्षेत्रमा उहाँहरुले गरेको योगदानको स्मरण गर्नुभएको थियो ।

वि.सं. २०६२/६३ मा सफलतापूर्वक सम्पन्न भएको ऐतिहासिक लोकतान्त्रिक जनआन्दोलनमा ऐक्यवद्धता जनाउँदै नेपाल भौगर्भिक समाजले जन आन्दोलनमा घाइते भएकाहरुको सहयोगार्थ स्थापित जनआन्दोलन प्राथमिक स्वास्थ्य उपचार कोषमा नगद रु. २०,००१/- (बीस हजार एक) उपलब्ध गराएको छ । यो समाज, उक्त महान जनआन्दोलनका शहीदहरुमा भावपूर्ण श्रद्धाञ्जलि अर्पण गर्दै, घाइतेहरुको शीघ्र स्वास्थ्यलाभको कामना गर्दछ । साथै, शहीदहरुको बलिदानबाट स्थापित लोकतन्त्रले देशमा दीगो शान्ति स्थापना गर्न सकोस् भन्ने कामना गर्दछ ।



रसिद नं : 1184 फोन नं :४-२२२४५०

जनआन्दोलन प्राथमिक स्वास्थ्य उपचार कोष

प्रदर्शनीमार्ग, काठमाडौं

जनआन्दोलनमा घाइते भई उपचारको सिलसिलामा काठमाण्डू मोडेल अस्पताल आएका बिरामीहरुको अत्यावश्यक प्राथमिक स्वास्थ्य उपचारको लागि आवश्यक खर्च जुटाउने पुण्यिल कार्यमा सहभागी हुनहुने जिल्ला KATHMANDU बस्ने श्री Nepal Geological society बाट सहयोग स्वरुप रु. 20001/= (अक्षरेपि. TWENTY THOUSAND ONE मात्र) नगद/चेक नं..... बाट मिति 2063-01-13 मा सधन्यवाद प्राप्त भयो ।

सहयोग प्रदान गर्नुहुने

बुझिलिने

26th GENERAL BODY MEETING OF NEPAL GEOLOGICAL SOCIETY
नेपाल भौगर्भिक समाजको छब्बीसौँ साधारण सभा

नेपाल भौगर्भिक समाजको **छब्बीसौँ वार्षिक** साधारण सभा, २०६२ भाद्र १७ गते (तदनुसार २ सेप्टेम्बर २००५) का दिन समाजका अध्यक्ष डा. रमेश मान तुलाधरको अध्यक्षतामा काठमाडौँ, लैनचौर स्थित खानी तथा भू-गर्भ विभागको ओडिटोरीयम हलमा सुसम्पन्न भएको थियो। उक्त अवसरमा सर्वप्रथम समाजका अध्यक्ष डा. तुलाधरले सम्पूर्ण सहभागी सदस्यहरुलाई अभिवादन गर्नुहुँदै स्वागत भाषण प्रस्तुत गर्नुभएको थियो। उक्त अवसरमा यस समाजका महासचिव श्री लीला नाथ रिमालले समाजले गत वर्षभरी भए-गरेका कार्यक्रमहरुका बारेमा विवरण प्रस्तुत गर्नुका साथै आ. व. २०६२–०६३ मा आयोजना गरीने कार्यक्रमहरुको बारेमा जानकारी गराउनुभयो। त्यसैगरी, उहाँले यस साधारण सभामा गरिने छलफल तथा एजेण्डाका बारेमा समेत जानकारी गराउनुभयो। उक्त अवसरमा, उहाँले सेप्टेम्वर २८–३० मा काठमाडौँमा हुन गैरहेको Fifth Asian Rigional Conference का बारेमा विस्तृत विवरण प्रस्तुत गर्नुभयो। साथै उहाँले यसका लागि लाग्ने खर्च, उठ्नसक्ने र अपुग हुन जाने रकम लगायत यस समाजका नेपाली सदस्यहरुलाई व्यक्तिगत रुपमा उक्त सेमिनारमा भाग लिन विशेष सहुलियत वापत रु १०००।- मात्र लिने यस समाजको कार्य समितिले निर्णय गरेको कुरा आवगत गराउनु भयो। यस पछि, कार्यक्रमलाई अगाडि बढाउने क्रममा यस समाजका कोषाध्यक्ष श्री जय राज घिमिरेले समाजको गत आ. व. २०६१/०६२ को आय-व्यय विवरण प्रस्तुत गर्दै खर्च बढी भई घाटा हुनका कारणहरु विस्तृत रुपमा अवगत गराउनु भएको थियो भने लेखा परीक्षणको विवरण समेत प्रस्तुत गर्नुभएको थियो। साथै, उहाँले हाल समाजसँग भएका सबै अचल सम्पत्तिहरुको विवरण समेत प्रस्तुत गर्नुभएको थियो। उहाँले समाजका नाउँमा एक पेन्टियम IV कम्प्युटर र फ्याक्स मेशीन किनेको समेत जानकारी दिनुभयो।

त्यसपछि, Fifth Asian Regional Confrernce का Convener Dr R. P. Bashyal ले हालसम्म Conference का सम्बन्धमा भए-गरेका कामका बारेमा सदस्य साथीहरुलाई जानकारी गराउनुभयो। अहिलेसम्म नेपालबाट जम्मा ३३ वटा Abstract आएका र बाहिरको तुलनामा उक्त सङ्ख्या ज्यादै न्यून भएकाले साथीहरुलाई पेपर लेख्न, प्रस्तुत गर्न र अरु साथीहरुलाई सहभागी गराउन अनुरोध गर्नुभयो। साथै, उहाँले Abstract हरु selection गर्न Scientific Committee को meeting बोलाएको जानकारी पनि दिनुभयो। उहाँले NGS का सबै Committee का Co-ordinator हरुलाई उक्त Conference का विभिन्न क्रियाकलापहरुमा सहयोग गरिदिनुहुन अनुरोध पनि गर्नुभयो।

त्यसपछि NGS को Honorary Membership प्रदान गर्न समाजले निर्माण गरेको Committee का तर्फबाट उक्त Committee का Co-ordinator Professor Dr B. N. Upreati ले Dr. A. Gansser र Mr. B. M. Pradhan को नाम प्रस्तुत गर्नुका साथै उहाँहरुले गर्नुभएका विभिन्न कार्यहरुको विस्तृत विवरण पेश गर्नुहुँदै सो Honorary Membership का लागि मनोनयनगरेको बारेमा प्रकाश पार्नुभयो।

उक्त अवसरमा, उहाँले Dr. A. Gansser ले नेपालको Geological Studies को क्षेत्रमा गर्नुभएको योगदानको समेत चर्चा गर्नुभयो। त्यसैगरि, Mr. B. M. Pradhan ले पनि नेपालमा भू-विज्ञानको क्षेत्रमा लामोसमयसम्म गर्नुभएका कार्यहरुको विवरण सहित उहाँको Biodata पेश गर्नुभयो।

त्यसपछि, समाजका सबै सहभागी साथीहरुलाई उक्त २ जना महानुभावहरुलाई Honorary Membership का लागि समर्थन गर्न जोडदार ताली बजाइदिनुहुन कार्यक्रम संचालक डा. सुरेशदास श्रेष्ठले अनुरोध गर्नुभएकोमा सम्पूर्ण साथीहरुले जोडदार रुपमा तालीबजाइ समर्थन गर्नुभयो।

त्यसैगरी, समाजका Associate Member श्री पदम कुमार राईलाई नेपाल भौगर्भिक समाजकालागि समाजको विधान अनुसार सदस्यता प्रदान गरियो।

त्यसपछि, महासचिव श्री लीला नाथ रिमालले National Group of IAEG को सदस्यता नवीकरण गर्ने वा नगर्ने सम्बन्धमा छलफल गर्नका लागि अनुरोध गर्नुभयो। यस सम्बन्धमा समाजका पूर्व अध्यक्ष श्री कृष्ण प्रसाद काफ्लेले ने. भौ. स. ले Institutional membership लिने र साथीहरुलाई सदस्य बनाउनु पर्ने धारणा राख्नुभयो। साथै उहाँले IAEG को सदस्यता लिनेले IAEG को Bulletin पाउने जानकारी पनि दिनुभयो भने समाजका सदस्य श्री रञ्जन कुमार दाहालले २ वर्ष अगाडि नै IAGE को Membership लिएको भएपनि हालसम्म IAEG को Bulletin नपाएकोमा आक्रोश पोख्दै Membership का बारेमा के भैरहेछ भन्ने बारेमा आफू अनभिज्ञ रहेको बताउनुभयो। समाजका पूर्व अध्यक्ष प्रा. डा. विशाल नाथ उप्रेतीले उक्त बुलेटिन Blackwell Scietific Publication ले प्रकाशन गर्ने जानकारी दिँदै, उहाँलाई IAEG मा सीधै पत्राचार गर्न सुझाव दिनुभयो। यसै सम्बन्धमा हाल ने. भौ. स. का कतिजना सदस्यहरु IAEG का सदस्य छन् भन्ने बारेमा समाजका सदस्य श्री जगदीश श्रेष्ठले प्रस्ट पार्नुभयो।

कार्यक्रम अगाडि बढाउने क्रममा समाजका अध्यक्ष डा. रमेश मान तुलाधरले राख्नुभएको सेवा, समुह, उपसमुह र भू-विज्ञानको सम्बन्ध निर्धारण बारे प्रस्तावमा सदस्य वक्ताहरुले आ-आफ्नो धारणा राख्नुभएको थियो। साथै, उक्त कार्यक्रमा सदस्यहरुले Job Creation का लागि समाजले अलग्गै कमिटी बनाउनुपर्ने र समाजका लागि घरजग्गा किन्न अविलम्ब कार्य गरिनुपर्ने धारणा समेत राख्नुभयो।

अन्त्यमा, समाजका अध्यक्ष डा. रमेश मान तुलाधरले छलफलमा उठेका सबै विषयहरुलाई मनन गर्दै सभाका सबै सदस्यहरुलाई धन्यवाद दिँदै सभा विसर्जन गर्नुभयो।

Best Wishes and

Hearty Felicitations

on

the Auspicious Occasion

of

Happy New Year
2063 B.S.

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Welcome speech by Dr Ramesh Man Tuladhar, President, Nepal Geological Society on the occasion of 26th General Body Meeting

यस ने. भौ. स. का सम्मानित सदस्य (Honorary Member) ज्यूहरु
भूतपूर्व अध्यक्षज्यूहरु
आदरणीय सदस्य साथीहरु
तथा पत्रकार मित्रहरु
नमस्कार !

यस समाजको छब्बीसौँ साधारण सभामा उपस्थित सम्पूर्ण आदरणीय सदस्य साथीहरुलाई यस समाजको तथा म आफ्नो तर्फबाट हार्दिक अभिवादन सहित स्वागत गर्दछु ।

आदरणीय सदस्य मित्रहरु,

समयको गतिले कसैलाई पर्खिदैन । यो ध्रुवसत्य यस नेपाल भौगर्भिक समाजलाई पनि लागु नै छ । अतः यस समाजको वर्तमान १२औँ कार्यकारिणी समतिको कार्यकालको प्रथम वर्षको कार्यावधि पूरा भैसकेको छ ।

आदरणीय सदस्य साथीहरु,

गत एक वर्षको अवधिमा यस समाजले धेरै-थोरै कृयाकलापहरु सम्पन्न गरेको छ । ती कृयाकलापहरु र भावी कार्यक्रमको विस्तृत प्रतिवेदन लगायत आज यस सभामा गरिने छलफलको Agenda आदि यस समाजका महासचिव श्री लीला नाथ रिमालबाट प्रस्तुत हुने नै छन् । साथै गत वर्षको, अर्थात् आ. व. ०६१।६२ को, वित्तीय प्रतिवेदन यस समाजका कोषाध्यक्ष श्री जय राज घिमिरेबाट प्रस्तुत गरिने छ ।

आदरणीय सदस्य साथीहरु,

यी औपचारिक प्रस्तुतीकरण पछि यस छब्बीसौँ साधारण सभाको एजेण्डा अनुसार विषयगत छलफल गरिने कार्यक्रम रहेको छ । सदा झैँ यस १२औँ कार्यकारिणी समितिले समाजका आदरणीय सदस्यज्यूहरु बीच भू-विज्ञान (Geoscience) सँग सम्बन्धित महत्वपूर्ण Issue हरु लाई सम्बोधन हुने गरी छलफल हुन र तत्पश्चात् सुझावहरु दिनुहुन आह्वान एवं हार्दिक आग्रह गर्दछु ।

आदरणीय सदस्य साथीहरु,

यति भन्दै म आफ्नो स्वागत मन्तव्य टुङ्गयाउन चाहन्छु र यस सभाका लागि तय भएका एजेण्डा अनुसार विषय प्रवेशका लागि यस १२औँ कार्यकारिणीका साथीहरुलाई आमन्त्रण गर्दछु। जय भू-विज्ञान !

धन्यवाद ।
डा. रमेश मान तुलाधर
अध्यक्ष
नेपाल भौगर्भिक समाज

Annual Report by Mr. L. N. Rimal, General Secretary, NGS

Mr. Chairman
Former Presidents
Respected Members of the Society

It gives me a great pleasure to welcome you all to the 26th Annual General Body Meeting of the Nepal Geological Society on behalf of the 12th Executive Committee and myself. It is already one year since we took the responsibility of the prestigious office of the Nepal Geological Society.

During the period we have put our efforts to the extent possible to enhance the activities of the Society and fulfil its objectives. In this context, firstly I would like to inform you about the major works completed during the year and then to inform you about the activities to be undertaken in the coming year.

The various works completed during one-year tenure are:

Observing the ISDR day

The Nepal Geological Society in close cooperation with the Ministry of Home Affairs, HMG Nepal; Department of Mines and Geology; Department of Water Induced Disaster prevention; UNDP-Nepal; NSET-Nepal; and ActionAid Nepal organised a one-day seminar on International Strategy for Disaster Reduction (ISDR) - Day on 13 October 2004 in the conference hall of the Tourism Board. About 135 participants from different national and international organisations took part in the meeting cum seminar where twelve technical papers were presented in three different technical sessions.

The Nepal Geological Society successfully organised a one-day seminar cum workshop on **Geological controls of Arsenic Contaminations of Groundwater in the Terai Region of Nepal** on 25 January this year in Kathmandu. The workshop was sponsored by the environmental office for South Asia, American Embassy and the South Asia Arsenic Project, US Geological Survey. More than 120 national and international scientists took part in the seminar.

Publication

The News Bulletin of Society (Vol. 21&22 in the combined form) as well as the Journal of Nepal Geological Society vol. 29 and the Proceedings of the Fourth Nepal Geological Congress, Special Issue, were published. We already started distribution to subscribers, members, and other institutions. We request all our members to purchase the journals and help towards making the publication sustainable. The News Bulletin of the Society is distributed free of cost to our respected members. A news version of the Nepal Geological Society Brochure is also published and is ready for distribution.

Observing the 25th anniversary of the Nepal Geological Society

A meeting cum discussion was organised on the occasion of the 25th anniversary of the Nepal Geological Society on 2 Baisakh this year in Kathmandu. Sixty-eight members of the Society participated in the programme. The three members of the Society: Mr Amod Mani Dixit, Dr Indra Raj Humagain, and Dr Ramesh Man Tuladhar, awarded by the Royal Nepal Academy for Science and Technology were congratulated by the Society during the meeting.

Respected Members of the Society,

The Society has gained a considerable strength in its membership. At present, the Society has 536 members and 4 associate members.

Dear respected members, I take this opportunity to inform about the major activities of the society to be undertaken very soon.

Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation

This conference is going to be held on 28-30 September 2005. The organisers have received a overwhelming number of response from the members of the society, professionals as well as concerned organisations and institutions throughout the world. We are organising this conference in the Hotel Yak & Yeti. We have approached the Crown Prince for the inauguration. Till now, we have received a positive response from the Secretariat of Crown Prince. We hope that the Crown Prince will grace the inauguration ceremony.

The Second Circular of the Conference was widely distributed to the members of various societies, professionals, concerned organisations, and institutions throughout the world.

Dr R. P. Bashyal, Convener of the conference, will elaborate upon other details of the conference.

Exhibition: We have planned to organise an exhibition during the conference in the conference venue. We have received letters of interest from various organisations.

Excursions: In connection with the international Conference, we are arranging two field excursions for our participants.

Financial aspects of the Conference: We have estimated the whole activities of the symposium by considering 300 confirmed participants. The expenditure of Rs. 18,85,000.00 and expected income of Rs. 12,56,000.00 lead to a deficit of Rs. 6,29000.00. We expect to raise this amount by the income from registration of the additional Nepalese participants and also from the contribution of local consulting and construction companies working in Nepal. Respected members, any activities of the Society could be considered successful only if it is participated by a maximum number of the members of the Society. Keeping this in mind and the cost of the symposium, we have fixed a very liberal registration cost of Rs 1000.00 only for the Nepalese members of the Society who will be joining the symposium individually. Any members of the Society wishing to register for the symposium could register in the NGS office. For those members who are busy at present, could also register on 27 September 2005 at the conference venue in the Hotel Yak & Yeti.

Dear members, whatever we are able to do during the year are due to your help, support, and advice. On behalf of the Executive Committee and myself, I would like to offer our sincere thanks to all of you for your active co-operation and continued support. Various governmental and nongovernmental organisations and agencies have provided technical and financial support to the society. The 12th Executive Committee would like to thank those organisations and agencies and hope that such co-operation continues in the future.

While working, there may have been shortcomings and weaknesses from our part. For this, I would like to take this opportunity to extend our sincere apology on behalf of the Executive Committee. At this moment, we would like to renew our request once again for the continuation of your support, advice, and co-operation as well as to point out our weaknesses. We sincerely hope that we will be guided by the respected members of the Society in the future.

Thank you all.

Annual Financial Report by Mr. J. R. Ghimire, Treasurer, NGS

नेपाल भौगर्भिक समाजका कोषाध्यक्ष श्री जय राज घिमिरेद्वारा प्रस्तुत आर्थिक प्रतिवेदन

श्रद्धेय सभाका सभापतिज्यू
सम्मानित सदस्यज्यूहरु
यस समाजका पूर्व अध्यक्षज्यूहरु
वर्तमान कार्यकारिणी समितिका साथीहरु
एवं सम्पूर्ण सदस्यहरु

सर्वप्रथम यस समाजको छब्बीसौँ साधारण सभाले आर्थिक गतिविधि हेर्ने महत्वपूर्ण जिम्मेवारी मलाई सुम्पिएकोमा यस समाजका सम्पूर्ण सदस्यहरुलाई हार्दिक धन्यवाद दिन चाहन्छु।

आदरणीय सदस्य साथीहरु,

आज म यस १२औँ कार्यकारिणी समितिले गत एक वर्षको कार्यकालमा गरेको आर्थिक विवरणलाई अधिकार प्राप्त लेखा परीक्षकबाट परीक्षण समेत गराई तपाईँहरु सामु पेश गर्न गइरहेकोछु। यसका मुख्य शीर्षकहरुमा भएको Income and Expenditure तथा Receipt and Payment सम्बधी सङ्क्षिप्त झलक तपाईँहरु समक्ष पेश गरि नै सकेको छु। अब म यस सम्बन्धी मोटामोटी विवरण उल्लेखगर्ने अनुमति चाहन्छु।

२०६१ श्रावण मसान्त (गत आ. व. को अन्त्य) सम्मको opening बैङ्क मौज्दात रु. २४,८५,७५६।२०
यस आ. व. (२०६१।६२) मा भएको आम्दानी र खर्च:
आम्दानी रु. ३,१२,८३६।१२
खर्च रु. ४,८०,९४७९६
आम्दानी भन्दा बढी खर्च रु. १,६८, १११।८४

उक्त खर्च रकममा मुख्य खर्चहरु गत साधारण सभाको तथा Triennial Dinner का लागि होटेल हिमालयमा भएको खर्च रु १०८,०४१।५०, NGS को Journal Vol. 29, Bulletin Vol. 21& 22 तथा IAEG Conference को Second Circular printing , stationery, letterhead printing आदि गरी रु. १०९,७७५।-, सन् २००४ तथा सन् २००५ को IAEG membership renewal fee का लागि भएको खर्च रकम रु. ४१,३५८।५१ र साथै घर भाडाका लागि रु. ३२,०००।- लगायतका खर्चहरु समेत समावेश छन् । साथै उक्त खर्च मध्ये आगामी IAEG conference committee का लागि Laser Printer, Canon 1600 model को फ्याक्स मेशीन समेत किनिएका छन्, जुन यस समाजको सम्पतिका रुपमा रहनेछन् ।

यस आ. व. मा भएका प्रमुख आम्दानीहरुमा Journal sale बाट रु. ५०,१४०।४८, Life तथा अन्य membership fee वापत रु. ५०,१२५।-, contribution, donation वापत रु. ५३,६५०।- आदि रहेकाछन् भने आर्थिक वर्षको अन्त्य तिर IAEG conference registration वापत भएको थप आम्दानी रु. १,१२,२५३।४४ समेत समावेश छ ।

अत: आर्थिक दृष्टिकोणले हेर्दा यो वर्ष समाजका लागि त्यति राम्रो वर्षका रुपमा लिन सकिँदैन । सङ्क्षिप्तमा हेर्दा समाजसँग हाल जम्मा रु. २७,९८,५९५।३२ को नगद सम्पति रहेको छ। साथै आगामी सेप्टेम्बर २८ देखि ३० मा IAEG Conference हुन गइरहेको कुरा यहाँहरुलाई अवगत भएकै विषय हो। यसैकारण आ.व. २०६२।६३ मा यस समाजका लागि आर्थिक गतिविधि बढी केन्द्रित हुनजानेछ।

यस समाजसँग हालसम्म रहेका अचल सम्पतिहरुको सूची यसैसाथ संलग्न छ। अन्त्यमा, म यो विवरण सदस्यज्यूहरु समक्ष प्रतिक्रियार्थ पेस गर्दछु ।

धन्यवाद।
२०६२।५।१७

Types of equipment and furniture owned by Nepal Geological Society as of 2062/4/32

S.N.	Description of items	Quantity	Status	Located at present	Remarks
1	Computer (P I, P IV)	2 Set	Good	1 Editorial Board, 1 Secretary	
2	Printer (LaserJet 6L LaserJet 1100, LaserJet 1300+	3 Set	Good	1 Editorial Board, 2 Secretary	
3	Fax Machine (Cannon 1600)	1 Set	Good	Editorial Board	
4	Steel Daraj (small and large)	6 Nos	Good	NGS office	
5	Wooden Table	1 Nos	Good	NGS office	
6	Chair (steel and wooden)	1Nos	Good	NGS office	6 steel and 6 wooden
7	Wooden display Board	2 Nos	Good	NGS office	
8	Wooden Rack	1 Nos	Good	NGS office	

Auditor's Financial Report (FY 2061/62)

Babu Raja Bajracharya
Registered Auditor

14 Bhadra 2062

The Members
Nepal Geological Society
Kathmandu.

Gentlemen,

I have audited the attached Receipt and Payment Account for the year ended 32nd Srawan 2062 and reports as follows:

1. I have got all the information and explanations which are required for the purpose of audit.
2. Proper books as required are maintained according to Company's Law.
3. The attached Receipt and Payment Account and Income and Expenditure Account are drawn properly up in accordance with records which are made available to me.
4. According to the information given to me the attached Income and Expenditure Accounts prepared for the year ended 32nd Srawan 2062 exhibit true and fair view.

Babu Raja Bajracharya
Registered Auditor

NEPAL GEOLOGICAL SOCIETY
RECEIPT AND PAYMENT ACCOUNT
For the year ended 32nd Srawan 2062

RECEIPT	AMOUNT	PAYMENT	AMOUNT
Bank (opening)	2,485,759.20	To Advance	10,000.00
By Advertisement	10,000.00	To Audit Fee	5,000.00
By Contribution	33,650.00	To Advertisement	2,970.00
By Donation	20,000.00	To Bank Charge	1,850.00
By Interest received	17,809.09	To Bank Charge ($14.13)	992.63
By Interest received ($68.08)	4,782.62	To Catering Service	7,260.00
By Journal Sale	40,024.48	To Communication	12,355.00
By Journal Sale ($144)	10,116.00	To Computer Accessories	74,500.00
By Membership fee	1,000.00	To Hotel bills	108,041.50
By Associate Membership fee	400.00	To Miscellaneous Exp.	1,285.00
By Life Membership fee	27,650.00	To Machinery Equipment	16,000.00
By Life Membership fee ($300)	21,075.00	To Membership fee	41,358.51
By Miscellaneous Income	762.99	To Printing & Stationary	109,775.00
By Miscellaneous Income ($50)	3,512.50	To Photo/film	1,710.00
By Registration fee	97,526.50	To Photocopy	4,190.00
By Registration fee ($337.75)	23,726.94	To Postage	13,452.00
By Entrance fee	800.00	To Refreshment	14,071.00
		To Remuneration,wages	10,800.00
		To Rent	32,000.00
		To Transportation	11,587.00
		To Tax on interest	1,033.07
		To Tax on interest ($10.21)	717.25
		By Balance	
		Nabil Bank(Saving)	118,427.40
		Nabil Bank(Fixed)	29,000.00
		Nabil Bank ($22043.17)	1,548,532.69
		Nepal Bank(Current)	9,949.68
		Nepal Bank(Saving)	50,923.50
		Agri. Dev. Bank(Saving)	408,712.96
		Agri. Dev. Bank(Fixed)	55,000.00
		By Misc.Loss(Diff. In Exchange Rate on $)	97,101.13
Total	**2,798,595.32**	**Total**	**2,798,595.32**

Note : US $ 1 = NRs.70.25

Treasurer	General Secretary	President	Auditor
J.R. Ghimire	L.N. Rimal	Dr. R.M. Tuladhar	B.R. Bajracharya

NEPAL GEOLOGICAL SOCIETY
INCOME AND EXPENDITURE ACCOUNT
For the year ended 32nd Srawan 2062

EXPENDITURE	AMOUNT	INCOME	AMOUNT
To Advance	10,000.00	By Advertisement	10,000.00
To Audit Fee	5,000.00	By Contribution	33,650.00
To Advertisement	2,970.00	By Donation	20,000.00
To Bank Charge	1,850.00	By Interest received	17,809.09
To Bank Charge ($14.13)	992.63	By Interest received ($68.08)	4,782.62
To Catering Service	7,260.00	By Journal Sale	40,024.48
To Communication	12,355.00	By Journal Sale ($144)	10,116.00
To Computer Accessories	74,500.00	By Membership fee	1,000.00
To Hotel bills	108,041.50	By Associate Membership fee	400.00
To Miscellaneous Exp.	1,285.00	By Life Membership fee	27,650.00
To Machinery Equipment	16,000.00	By Life Membership fee ($300)	21,075.00
To Membership fee	41,358.51	By Miscellaneous Income	762.99
To Printing & Stationary	109,775.00	By Miscellaneous Income ($50)	3,512.50
To Photo/film	1,710.00	By Registration fee	97,526.50
To Photocopy	4,190.00	By Registration fee ($337.75)	23,726.94
To Postage	13,452.00	By Entrance fee	800.00
To Refreshment	14,071.00	By Excess of expenditure over	168,111.84
To Remuneration,wages	10,800.00	income	
To Rent	32,000.00		
To Transportation	11,587.00		
To Tax on interest	1,033.07		
To Tax on interest ($10.21)	717.25		
Total	**480,947.96**	**Total**	**480,947.96**

Note : US $ 1 = NRs.70.25

Treasurer	General Secretary	President	Auditor
J.R. Ghimire	L.N. Rimal	Dr. R.M. Tuladhar	B.R. Bajracharya

DIP CONSULTANCY (P.) LTD.

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CONSULTING ENGINEERS, ARCHITECTS, AND PLANNERS

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- GEOLOGICAL AND GEOPHYSICAL EXPLORATION
- SOCIO-ECONOMIC AND ENVIRONMENTAL STUDIES
- TOPOGRAPHICAL SURVEY
- PRODUCTION OF MULTICOLOURED MAP
- WATER RESOURCES PLANNING AND DEVELOPMENT
- CONSTRUCTION SUPERVISION

PO BOX: 4903,
Tel: 4418010, 4429645
Kalikasthan, Dillibazar,
Kathmandu, Nepal

SOCIETY ACTIVITIES

Dr R. M. Tuladhar, President of NGS, welcoming all participants in the 26th General Body Meeting of NGS

Mr L. N. Rimal, General Secretary of NGS, presenting annual report of Society in the 26th General Body Meeting of NGS

Mr J. R. Ghimire, Treasurer of NGS, presenting the annual financial report in the 26th General Body Meeting of NGS

Members of Executive Committee in the 26th General Body Meeting of NGS

Participants in the 26th General Body Meeting of NGS

ABSTRACT OF PAPER PRESENTED IN GEOSCIENTIFIC TALK PROGRAMME

Lesser Himalayan Tertiary beds of far west Nepal and their comparison with Chakrata (Saknidhar) and Rautgara Formations of Kumaon, India

Megh Raj Dhital
Central Department of Geology, Tribhuvan University
Kirtipur, Kathmandu, Nepal
(Email: mrdhital@wlink.com.np)

In the inner Lesser Himalaya of west Nepal, the Tertiary rocks are made up of red-purple, brown, and grey-green sandstone and shale with sporadic lenticular limestone beds of the Chuchura Formation containing nummulites and bivalvia fossils of Eocene epoch. These rocks continue in the adjoining border region of the Kumaun Lesser Himalaya, India, where they are mapped as the (?) Precambrian Rautgara Formation (Valdiya 1980) at its type locality near Pancheshwar.

The Tertiary beds of Far West Nepal are represented by the Chuchura Formation (Fig. 1) made up of red-purple or brown shale interbedded with grey-green sandstone. This formation is sandwiched between the south-dipping North Dandeldhura Thrust (NDT) and the north-dipping Pachkora Thrust. The NDT brings with it schists and gneisses of the Dandeldhura Group and is a continuation of the Almora Thrust sheet in India. On the other hand, the PT brings with it the Patan Formation of slate and quartzite. In this area, the Patan Formation is repeatedly folded and exhibits the features of superposed folding.

The detailed study of lithofacies and sedimentary structures of the Tertiary rocks in the Kumaun Lesser Himalaya, especially at Rautgara, in the Hewal Nadi, around Nilkanth, on the Rishikesh–Badrinath Road, in the vicinity of Khadi, between Chham and Dharasu, and south of Chakrata revealed that the rocks are made up mainly of fining-upward fluvial cycles underlain by shallow marine deposits. The Tertiary rocks exposed in a window between Saknidhar and Deoprayag exhibit mainly fluvial deposits with large-scale cross-beds and fining-upward cycles (Fig. 2). Coal seams were encountered north of Chham, whereas some Eocene fossils were recovered at Bachhelikhal situated on the Rishikesh–Badrinath Road.

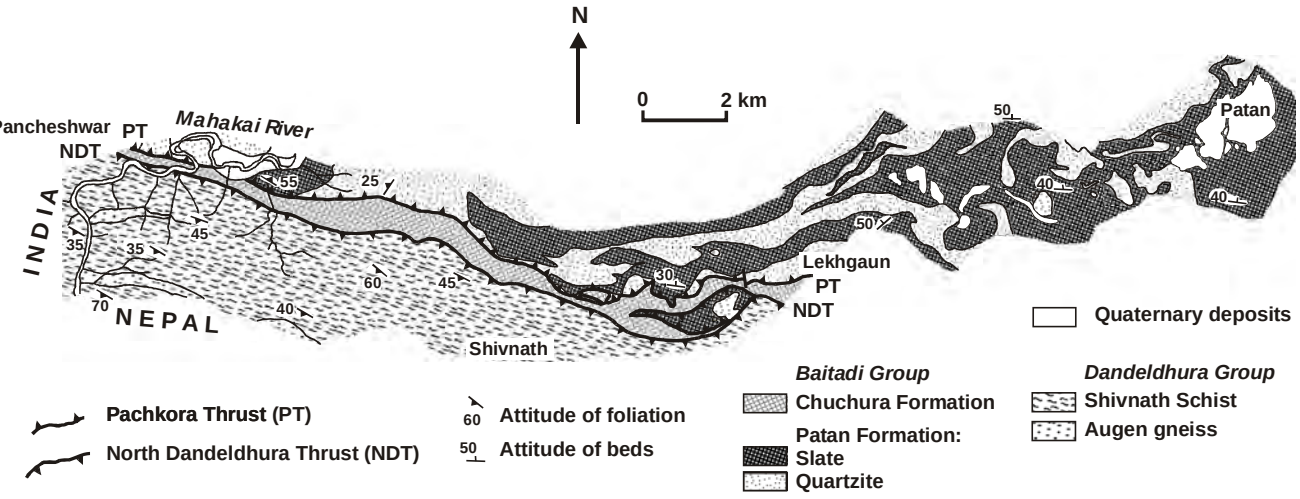

Fig. 1: Geological map of Pancheshwar area in far west Nepal showing the Tertiary beds of the Chuchura Formation sandwiched between the North Dandeldhura Thrust and the Pachkora Thrust

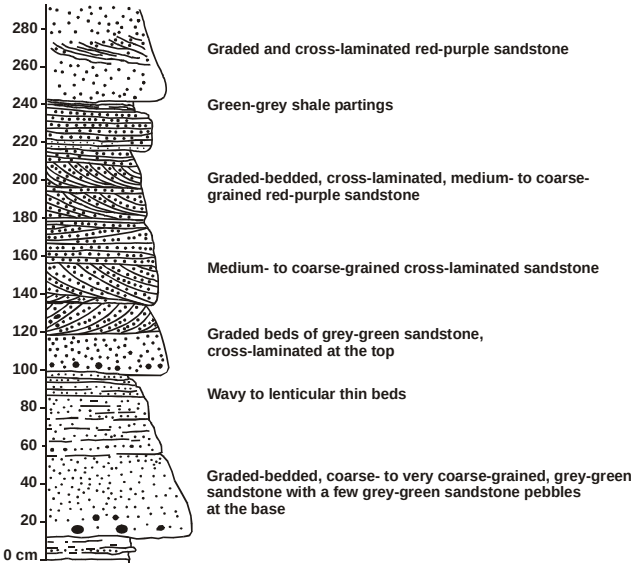

Fig. 2: Graphic log of the sedimentary sequence showing fining-upward cycles with graded bedding, cross-lamination, and parallel laminae at Saknidhar, on the Rishikesh–Badrinath Road, Uttaranchal, India

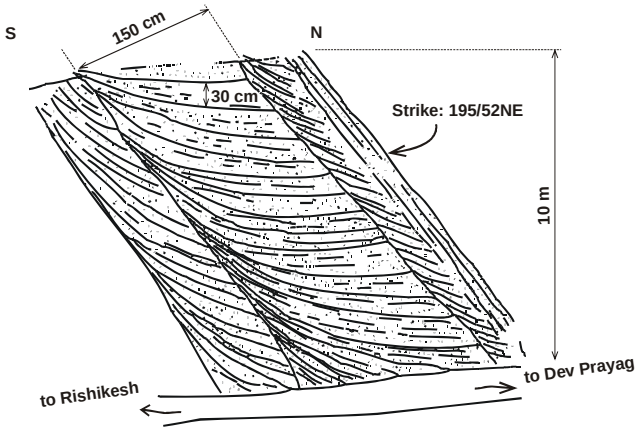

Fig. 3: Sketch of large-scale cross-bedding observed in the Chakrata (Saknidhar) Formation at Saknidhar, on the Rishikesh–Badrinath Road, Uttaranchal, India

At Saknidhar, the Chakrata (Saknidhar) Formation frequently contains very thick (from 1 to 20 m, and rarely up to 50 m), medium- to very coarse-grained, cross-bedded as well as parallel-laminated, purple and grey-green, mottled sandstone cycles followed by grey-green shale successions. A shale succession is from 3 to 10 m thick. In the sandstone, tiny muscovite flakes are observed. At Saknidhar, large-scale cross-beds (Fig. 3) are also found. The foreset beds contain small ripples. At the bottom of some sandstone beds, 20 to 30 cm wide load casts are also present.

All the above sedimentary structures as well as fossils point out to their fluvial and shallow marine environment of deposition.

Reference

Valdiya, K. S., 1980, *Geology of Kumaun Himalaya*. Wadia Institute of Himalayan Geology, 291 p. (with maps).

FIFTH ASIAN REGIONAL CONFERENCE ON ENGINEERING GEOLOGY FOR MAJOR INFRASTRUCTURE DEVELOPMENT AND NATURAL HAZARDS MITIGATION

28–30 September 2005, Kathmandu, Nepal

The Nepal Geological Society in collaboration with the International Association for Engineering Geology and the Environment (IAEG) organised the Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation from 28 to 30 September 2005 in Kathmandu, Nepal.

The Conference was inaugurated by Professor Dr. Govind Prasad Sharma, Honorable Vice Chancellor, Tribhuvan University. In his inaugural speech, he congratulated the Nepal Geological Society for organising such an international event with participation of many countries of the world. He emphasised that the outcome of this conference will help in developing the basic infrastructures for natural disaster reduction in our country.

Professor Sharma pointed out that due to the importance of applied geology, Tribhuvan University has started the specialisation in engineering geology, environmental sciences, geotechnical engineering, and studies on earth hazards and mountain risk engineering.

On this occasion, Honorary Membership of the Nepal Geological Society was conferred to two distinguished geoscientists, Professor Dr A. Gansser of Switzerland and Mr B. M. Pradhan of Nepal for their contribution to research and development of geoscience in the Himalayas.

Welcoming the participants, Dr R. M. Tuladhar, President of Nepal Geological Society, expressed his confidence that the outcomes of the research and working papers deliberated in the conference will certainly be a solid contribution towards the sustainable infrastructure development.

Dr R. P. Bashyal, Convener of the international symposium, highlighted the status of the conference. He also pointed out that such a meeting being organised in Nepal provides a forum to the scientists of the region to interact with their counterparts from the developed countries. The General Secretary of the Nepal Geological Society, Mr L. N. Rimal gave the vote of thanks.

There was an email message from Dr Niek Rengers, President of the International Association of Engineering Geology and the Environment (IAEG), addressed the conference, which was read out by the Convener. In his address, he thanked the organisers for their effort and highlighted the importance and relevance of such a conference in the Asian region. He mentioned that a Federation of International Geo-engineering Societies (FIGS) was formed and a new communication system for the IAEG members with the Bulletin and IAEG website were developed.

The symposium was attended by 209 geoscientists from 22 countries. The participants were from the following countries:

SAARC: Bangladesh, India, and Nepal;

Asia-Pacific Region: Japan, Iran, Malaysia, Korea, and Thailand;

Australia;

European countries: Austria, Kazakhstan, Russia, France, Germany, Italy, the Netherlands, Norway, Romania, Sweden, and the United Kingdom;

African Continent: Egypt;

North America: Canada; and

South America: Columbia.

During the three-day long Conference, 73 technical papers were presented in 18 sessions. The sessions were grouped into the following three main topics:

- Engineering Geology,
- Hydrogeology, and
- Natural Hazards and Environmental Geology.

After the end of the Technical Sessions, a Valedictory Session was conducted. It was chaired by Dr Ramesh Man Tuladhar, President of the Nepal Geological Society. On this occasion, the Convener presented a brief report of the Conference and thanked all the participants and the sponsors of the Conference. In this session, eminent geoscientists from eight different countries expressed their views regarding the importance of the conference and the achievements that could be gained through such an international event.

After the symposium, a four-day Excursion No. 1 to Kathamandu–Pokhara–Baglung–Kathmandu and a one-day Excursion No. 2 to Kathmandu–Kodari–Kathmandu were also organised. These excursions were attended by 18 and 10 participants, respectively. The participants observed various engineering geological problems on the mountain roads of Nepal, visited a few hydropower projects, and became acquainted with the geology of Nepal Himalayas.

A total of 73 scientific research or working papers including

six keynote addresses were presented in the symposium. Out of which about 30 full papers have been received by now.

The Society will publish the proceedings of the symposium in the Journal of Nepal Geological Society by the end of 2006 after international review and editing. Only those papers that were presented personally will be accepted for publication.

The Nepal Geological Society received financial support from Cairn Energy PLC, UK; Nepal Electricity Authority (NEA); DDC-JV, Udipur, Lamjung; UNDP/Nepal; Nepal Environmental and Scientific Services (NESS) and SILT Consultants. Their generous financial assistance is sincerely acknowledged.

Inaugural Ceremony of the Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation, 28 to 30 September 2005, Kathmandu, Nepal

Chief Guest, Honourable Professor Dr Govind Prasad Sharma, awarding Mr B. M. Pradhan with the Honorary Membership of Nepal Geological Society

Welcome Speech by Dr Ramesh M. Tuladhar, President, Nepal Geological Society

Chairman, Mr. Nanda Ram Sthapit, D. G., Deptartment of Mines and Geology
Honourable Chief Guest, Professor Dr Govind Prasad Sharma, Vice Chancellor, Tribhuvan University
Distinguished Delegates
Fellow Members
Media Personnel
Ladies and Gentlemen

On behalf of the Nepal Geological Society and on my own, I am delighted to be here to welcome you all to the **Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation** being held in Kathmandu from today until 30 September 2005. We are indeed honoured by the gracious presence of distinguished foreign guests representing over 25 countries despite uneasy security situation in the country.

Mr. Chairman! Kindly allow me to share a few facts of the Nepal Geological Society. It is a non-profit, non-governmental, non-political but a very professional scientific society solely devoted towards enhancing geoscientific activities in the national and international arena. It was founded 25 years ago in 1980. This year is the Nepal Geological Society's Silver Jubilee year. Some additional relevant information is displayed on the screen as well.

Mr. Chairman! It would not be an exaggeration to mention that the Nepal Geological Society has by now established its image in national and international arena as a valuable geoscientific organisation. Several national and international seminars, symposiums, conferences, and congresses may be listed to its credit. The publication of scientific journals without any interruption since its inception has been our pride that directly reflects the devotion, dedication and determination of our national geoscientific community. Today we all are assembled here to share our knowledge and research information focused on engineering geological aspects amongst the geoscientists of Asia, in particular.

Mr. Chairman! Our world is challenged by so many natural hazards induced by water, tectonics, geology, and topography, often times resulting in catastrophic disasters.

Seemingly, these disasters do not have any political, sociological, or economical boundary. Last year, Asia suffered a lot from an earthquake-induced tsunami disaster and now the United States is suffering from a hurricane disaster. Whenever such disasters occur, infrastructures are damaged to a great extent challenging the engineering design. In this regard, therefore, the importance of the present Conference has increased by many folds.

Mr. Chairman! Nepal is prone to several natural hazards and the major infrastructures built here are endangered. Important infrastructures such as the Mugling–Narayanghat Road, the artery of the capital city of Kathmandu are blocked for several weeks due to landslides and debris flows creating a socioeconomic havoc in the country. Further, almost all hydroelectric power plants installed here are located in geotectonically vulnerable areas and facing problems due to geological phenomena. Therefore, it is emphasised that geoscientists have to play a major role, particularly in this geotectonically complicated Himalayan terrain as a partner in the sustainable development of natural resources, urbanisation and major infrastructures development that include hillside roads and hydroelectric power in Nepal.

Mr. Chairman! We all know that natural phenomena such as earthquake, soil erosion, flood, and landslide leading to natural disasters can not be stopped but can be minimised by proper engineering design and management. Many natural phenomena taking place at one end of the Himalayas have a great bearing on the other. Therefore, we need more interaction, co-operation, and collaboration at national and international levels for the further development of geoscientific works to face the challenges that lie ahead of us.

Finally, once again I extend my warmest welcome to all honourable participants to this august gathering. I wish you all a fruitful deliberation in the conference and a pleasant and enjoyable stay in the historic city of Kathmandu.

Thank you so much.

Speech by Chief Guest, Honourable Professor Dr Govind Prasad Sharma, Vice Chancellor, Tribhuvan University

Mr. Chairperson
President, Nepal Geological Society
Mr Bishwa Man Pradhan
Dr D. N. Petley
Convener, Dr R. P. Bashyal
Mr L. N. Rimal
Members of Nepal Geological Society
Distinguished Foreign and Nepalese Participants
Ladies and Gentlemen

It is a great privilege and honour for me to be invited to this august gathering of the **Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation** giving me the opportunity to inaugurate this important international meeting of the Society.

I congratulate the **Nepal Geological Society** for organising this international event and being able to bring together scientists from 26 countries of Asia, Europe, America, Australia, and Africa in order to develop the engineering geological knowledge for sustainable development of infrastructures and mitigation of natural hazards in our Himalayan and other regions of the world.

I am also happy to know that the Society has established a tradition of International cooperation and joint efforts in uncovering the geological mysteries of the Himalayas, in exploring and developing the mineral and water resources of the region, and in controlling geological hazards.

Distinguished Geoscientists,

In a developing country like ours, the development of basic infrastructure, harnessing the natural resources such as water, mineral and forest, are vital for the upliftment of people's life and ultimately in reducing poverty of the region.

Our Himalayan region is composed of young and fragile geological structures. Therefore, proper engineering geological procedures should be followed to develop all the basic infrastructures and to explore the natural resources. The geoscientific research equally plays an important role in reducing the loss of life and property due to natural disasters such as earthquake, flood, landslide, soil erosion, glacier lake outburst, and environmental degradation in our region

Considering the development scenario of our country, Tribhuvan University has commenced the specialisation in Engineering Geology, Environmental Sciences, Geotechnical Engineering, and studies on Earth Hazards and Mountain Risk Engineering.

I believe the scientific papers presented and discussed in the technical sessions will provide encouragement and guidelines to all Nepalese geoscientists and help to plan their future geoscientific works for national development, especially in the field of engineering geology for the development of major infrastructure with new thoughts and theories.

It was nice to witness honouring two of the eminent geoscientists with the honorary membership of the Society: Professor Dr A. Gansser, renowned geoscientist on Himalayan geology from Switzerland and Mr Bishwa Man Pradhan, one of the pioneer geologists of Nepal. I take this opportunity to congratulate both of these eminent geoscientists.

I hope that a brief stay of our foreign guests in Kathmandu will be comfortable and pleasant. I thank the organisers once again for giving me this opportunity to be with you and share some of my feelings. I wish a grand success to this scientific congress.

Thank you very much for your kind attention.

Speech by Chairman, Mr N. R. Sthapit, Director General, Department of Mines and Geology

Honourable Chief Guest, Professor Dr G.. P. Sharma, Vice Chancellor, Tribhuvan University
President, Nepal Geological Society
High Dignitaries from the governmental and other organisations
Distinguished Guests and Participants
Members of Nepal Geological Society
Ladies and Gentlemen

It is a great privilege and honour for me to be invited to this august gathering and chair the Inaugural Ceremony of the **Fifth Asian Regional Conference** organised by the Nepal Geological Society. I sincerely would like to thank the organisers for giving me this opportunity.

I know that the Nepal Geological Society is highly devoted to expand and upgrade the geological knowledge by geoscientific researches in the country since its establishment in 1980. The Society is providing better forum for closer interactions, sharing of experiences and ideas among geoscientists of the world by organising seminars, symposia, workshops, and talk programmes, and disseminating the research findings through its regular scientific publications like the Journal of Nepal geological Society. It is commendable that the Journal of NGS has worldwide circulation.

In this developing world the role of geoscientists is increasing day by day and their activities are diversified from traditional mineral exploration and development to engineering and environmental geology, land use and infrastructural development, hazard mitigation, and environmental protection. Nowadays, geoscientific knowledge is applied in various developmental works; from planning, and designing to the implementation stage.

I would like to assure you that the H.M.G. and its various organisations related to geology will continue their cooperation and support to the Society in all geoscientific research and developmental activities.

I am delighted to know that about 225 geoscientists from 26 countries are participating to deliberate their research findings in the congress. I am sure, the technical session to be followed will provide an ample opportunity to the Nepalese geoscientists to interact and share their views with the international geoscientific community. Let us hope the results of the congress will provide some guidelines for future research and development in the Nepal Himalaya.

I wish for a grand success of the congress.

Thank you for your attention.

Speech by Dr Ramesh P. Bashyal, Convener, Fifth Asian Regional Conference

Chairman, Mr Nanda Ram Sthapit, Director General, Department of Mines and Geology
Chief Guest, Honourable Professor Dr Govind P. Sharma, Vice Chancellor, Tribhuvan University
Dr R. M. Tuladhar, President, Nepal Geological Society
Distinguished Guests and Participants

On behalf of the Organising Committee and all the members of the Nepal Geological Society, I would like to express my sincere gratitude to our Chief Guest who kindly accepted our invitation to inaugurate this Conference. Similarly, I am grateful to our Chairman for his consent to chair this Session within a short period of our invitation.

I extend a very warm welcome to all the foreign participants from many countries and to our Nepalese geoscientists. We are greatly honoured by your presence here in this Conference.

Nepal Geological Society, founded in 1980, had observed its Silver Jubilee recently. It has emerged as an important prestigious scientific society of the country. The activities of national and the international levels (seminars, congresses, conferences and symposium etc. and the publication of the scientific journals) are regularly being carried out by the

Society and has established networking with international geological institutions.

Our Society is a country member of the International Association for the Engineering Geology (IAEG). We jointly organised an International Conference on Engineering Geology, Hydrogeology, and Natural Disaster with emphasis on Asia from 28 to 30, September, 1999 here in Kathmandu which was inaugurated by **Late His Majesty The King Birendra Bir Bikram Shah**. The Conference was attended by 419 participants from over 34 countries.

As our second geoscientific cooperation with IAEG, the organisation of this Conference was initiated three years back. With a focus on issues and problems of engineering geology in Asia, this **Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation** is organised by Nepal Geological Society in collaboration with IAEG.

Engineering Geology is such a branch of modem science and technology, which is aiming in realising the approach of sustainable development through the coordination of human engineering activity and the geoenvironment. Engineering geologists should undertake the task of environment protection and its rational use. It is dedicated to the investigation, study and evaluation of the geological and environmental problems. So the engineering geologists should ensure the economy and safety of infrastructure construction and exploitation of natural resources, and equally ensure the environment quality and safety.

Today, we are gathered here to exchange and discuss the outcome of the research and the advancement and innovations in the field of engineering geology. Hence, the three main conference themes: **Engineering Geology, Hydrogeology, and Natural Hazards and Environmental Geology.**

Engineering Geology covers the subjects on hydropower structures, site investigation, underground excavation, foundation engineering, irrigation structures, highway and roads, construction materials, dimension stones, soil erosion and, education and training.

Hydrogeology has subthemes as hydrochemistry, runoff, water pollution and groundwater. Natural Hazards and Environmental geology covers the topics on landslide and debris flow, floods, earthquakes, cyclones, volcanic eruptions, glacier lake outburst floods, hazard and risk management, remote sensing and GIS, soil bioengineering, case studies, modelling of natural hazards, and natural disaster management and mitigation

We received over 200 replies from 35 countries in response to our first announcement. Finally, we have now about 225 participants from 26 countries attending the conference representing the continents Africa, America, Asia, Australia and Europe. Out of 116 abstracts received and published, a total of 95 papers will be presented in 18 technical sessions of this conference during these three days in two parallel sessions. There are 6 keynote papers by prominent geoscientists.

Two field excursions with engineering geological importance are planned after the conference. The first excursion of 4 days will be conducted along Kathmandu–Mugling–Pokhara–Baglung road including the visit to Marsyangdi and Modi Hydropower projects. The second excursion will be conducted along the Arniko Highway towards China border. Many foreign participants are attending these field excursions.

The Society has received great support and cooperation from many organisations and the individuals during the preparation of this conference. On behalf of the organising committee and on my own, as the Convener of this conference, I would like to express my sincere thank to international and national organisations such as Cairn Energy PLC, Edinburgh, UK, UNDP/Nepal, ICIMOD, NEA, DDC-JV, NESS, Silt Consultants and many others. I am grateful to the logistic support and the participation of many governmental organisations, engineering consulting firms and the members of the Nepal Geological Society, and the students of geology departments.

I am aware that there have been many shortcomings which may have caused inconvenience to the participants. I sincerely apologise on behalf of the Organising Committee.

Once again, I welcome all distinguished participants to this conference. I wish a pleasant stay to the foreign participants in our ancient Kathmandu city.

I hope we will have a very fruitful deliberation in the conference and your active participation will make this international geoscientific event, a success.

Thank you very much distinguished guests and participants.

Address by Dr Neik Rengers, President of the International Association of Engineering Geology and Environment (IAEG)

Dear Colleagues, members of the International Association of Engineering Geology and the Environment and other Geo-Engineering Specialists from the Asian Region.

I apologise for not being able to participate in the **Fifth Asian Regional Conferences on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation**. However, I am very glad that I was offered an opportunity to address this gathering of geoscientists from national and regional levels. It is through the relentless work of IAEG members worldwide that our association is alive. I thank the organising committee of this Regional Conference for the large amount of work, which they have done to make this Conference a success. The theme is very relevant, especially in the Asian region, where economical growth is very strong and infrastructure needs improvement to cope with increasing demands of mobility and transportation. It is now generally accepted that the development of major infrastructure needs geo-engineering investigations to select the most proper location for the structure, taking into consideration the geotechnical terrain characteristics and the vulnerability to natural hazards.

On this occasion, I would like to inform you about a number of important developments in our Association.

A very important issue for our Association is the collaboration with the other international geo-engineering associations, such as the International Society for Rock Mechanics (ISRM) and the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE). After years of competition, we have decided to work together there where the challenges cannot be met by each of the individual association. The councils of the three associations have agreed in principle to form together a Federation of International Geo-engineering Societies (FIGS). We hope that this will lead to the formal start of the Federation in 2007.

Another important development is that the world is becoming smaller through the increased possibilities of communication. The IAEG Executive Committee is doing its best to make use of the new communication techniques to close the gap with the individual IAEG members worldwide. We have worked hard in the last few years along the following lines:

- Our **Bulletin** is published by Springer and appears 4 times per year at a regular time interval with increasing numbers of printed pages and peer-reviewed papers of high quality. You can access the papers also through the Springer website, the details of which can be found in the Bulletin and on our new IAEG website.

- Our own new website **www.iaeg.info** is also in operation. The first part, which is providing information on IAEG, its National Groups and Commissions, is accessible to all. The second more interactive part, which is accessible only to IAEG members, is presently under construction and hopefully will be on the air before the end of the year. The website is a very important means of access for the individual members worldwide to the important news about all activities of the Association. I invite you all to have a look and mail us your impression and suggestions.

- Our Technical Commissions are working on relevant themes which are defined by our Council. We have formed a number of Joint Technical Committees together with ISRM and ISSMGE. The products of the work of these JTC's are made accessible to the IAEG members through our website.

Enough about the IAEG; and how it works to serve you better as geo-engineering practitioner and/or geo-engineering scientist.

Let me end these few words today with the wish to all of you that this Regional Conference becomes fruitful. I look forward to meeting you all soon in the interactive virtual environment of our website.

Thank you.

Speech by Dr R. P. Bashyal, Convener of the Fifth Asian Regional Conference

We would like to make this Session very short. We have came to the end of the Technical Sessions or at the end of the Conference also, and as a convener, I will just give you a very brief report of the Conference and then I would like to invite a few of our guests to say a few words about this Conference, their opinion and comments and then we will hand over to our Korean friends who will arrange the next IAEG Conference in Korea. This is how we will do. Let me start with a brief report on the whole conference that we actively participated. The NGS in collaboration with the International Association for Engineering Geology and the Environment (IAEG) and the Asian Regional Group of IAEG organised this seminar from 28 to 30 September 2005, in Kathmandu, Nepal. Of course, we received a lot of support and co-operation from various national and international organisations to organise this Conference here.

On the first day, the Conference was inaugurated by Honourable Professor Dr Govind Prasad Sharma, Vice Chancellor of Tribhuvan University, and on that occasion we awarded or confirmed the honorary membership of the NGS to two distinguished Geoscientists, Professor. Dr Augusto Gansser from Switzerland and Mr Bishwa Man Pradhan from Nepal. And then we had the welcoming speech by the President of NGS, Dr Ramesh Man Tuladhar, who expressed his confidence that the outcomes of research works and working papers deliberated in this Conference would certainly be a solid contribution towards the sustainable infrastructure development in Nepal. As a convener in opening session, I just highlighted the status of the Conference and I pointed out that the meeting organised in Nepal provides a forum for the scientist of the region to interact with their counterparts from other countries. At the end of the Inaugural Session, General Secretary of the NGS, Lila Nath Rimal, gave the vote of thanks.

In the mean time, I had received a message from Dr Neik Rengers, who is the President of the IAEG. Unfortunately, we could not get his address to the Inaugural Session of the Fifth Asian Regional conference on the same day, but got it the next day. Then, I read the message in one of the morning sessions here in this Conference. If I am allowed, I would mention just a few things Dr Rangers mentioned in his address. He wrote that the Conference theme was very relevant, especially in the Asian region where economical growth is strong and infrastructures need improvement to cope with the increasing demands of mobility and transportation, and he stated that it is generally accepted that the development of major infrastructures needs geo-engineering investigation to select the most proper location of the structure, taking into consideration the geotechnical terrain characteristics and the vulnerability of natural hazards. And he also mentioned some other important developments of the IAEG, such as it will from a Federation of International Geo-engineering Society (called FIGS) together with the International Society for Rock Mechanics and International Society for Soil Mechanics and Geotechnical Engineering. He also mentioned the publication of the IAEG Bulletin by Springer and communication facilities with the opening of a new IAEG website: www.iaeg.info and the possibility of getting the IAEG Bulletin from the same website or directly from the Springer website.

That was the first day. Then, we started the technical sessions. Please let me briefly summarise the technical sessions. The conference was attended by 209 geoscientists from 22 countries, according to the final list we have. There could be one or two countries more or the participation number may be a little different, but this is what I have at present. The participants were from Bangladesh, India, and Nepal from SAARC region; Japan, Malaysia, Iran, Thailand, and Australia from the Asia–Pacific region; Austria, France, Germany, Kazakhstan, Russia, Italy, the Netherlands, Norway, Romania, Sweden, and the UK from the European countries; and Egypt from the African continent. We have the participation from Canada, North America; and we also have one participant from Columbia, South America.

During this three-day long conference we had some 18 technical sessions. There were three technical themes: engineering geology, hydrogeology, and natural hazards and environmental geology. The themes were grouped generally in two parallel sections, but on the first day we had only a few papers on hydrogeology, and that also was included in one of the two parallel sessions.

That's all we have so far. And after the Technical Sessions, now we are in this Valedictory Session. From tomorrow, we will have Field Excursion I and Field Excursion II, and I think the participants have received the information about the excursion and have met with their respective leaders.

Now I would like to summaries the presentations. We had six keynote addresses from different prominent geoscientists. In the Engineering Geology Session 32 papers were read out, and in Hydrology I think we had only two. Of course, we also had six posters here. In the Natural Hazards and Environmental Geology theme we had 27 papers, so

altogether, I think we had 73 papers. I would like to request you that the NGS will be publishing the proceedings of this conference in the Journal of Nepal Geological Society. I think it is the same format that we have used in our last IAEG conference here in Nepal. So, all the criteria of paper submitting, its format, and other relevant information are mentioned in the Journal of Nepal geological Society. After the peer-review, formatting, and editing by our Editorial Board, we will publish the papers. I think that it may be published before the end of the 2006. Therefore, I request, as a Convener, all the participants who have presented the paper to submit their full papers. We have received so far some 16 or 17 papers already during this conference. The presenters who have not yet submitted their papers are requested to submit within one month. If you want some more details, pleas contact our Chief Editor.

This is all I have to say and now I would like to invite a few of our guests or representatives from different countries. I request them to make their comments brief, because I know that during these 3 days, you are very tired and would like to take some rest. First of all, I would like to invite Dr D. N. Petley from the UK, to give his comments about this conference.

Thank you.

Speech by Dr D. N. Petley, Participant from the UK

Chairman

Thank you very much for invitation to say a few words here. I very much appreciate it. It is most interesting to have the opportunity to reflect on the conference, most interesting meeting it has been. For me, there have been a number of highlights. I thought I will mention a few. First of all, the very first paper of the Conference was the one by Professor Dr Upreti. He talked quite unusually, I think, about the successes as there have been trying to deal with hazards in Nepal and it was quite inspiring to hear the paper, where he talked about good things and not necessarily the bad; but that was nicely balanced by the paper presented by Dr Dhital, where he talked about some of the failures and some of the problems that are associated with, in particular, the road sector in Nepal, and to me the mention of green road concept actually being a brown road concept was, particularly interesting.

Overall, as I have listened to the papers, it seems to me that a theme that has emerged throughout the meeting has been one on the environmental change in the Asian region, particularly in the Himalaya. By environmental change, I don't just mean the climatic change or obviously that is an important part of it. Environmental change includes, for example, deforestation. Although some people like Jacobs claimed deforestation is not that serious as perhaps as we may tell changes in agricultural practices in many parts of Nepal. We see a more towards the abandonment of traditional agricultural practices and perhaps lots of synpractices and there are environmental impacts associated with that and the effect of road building and the growth of urban areas partly due to the rather abrupt population growth within the country, and this is mirrored through whole of the South Asian region and actually more throughout Asia in general. One should not neglect the impact of climatic change as well and it seems to me that over time we are becoming more confident and we can have agreement about whether the change is due to natural processes or anthropogenic processes, but the observation, for example, in the high mountain areas the temperature is changing at over 0.1 ^{o}C per year and that, in fact, let the height of the permafrost melting to increase by 500 meters in last 30 years is particularly interesting and recent papers on the hydrology of Nepal have also suggested that although the rainfall totals probably aren't changing in long terms in Nepal. We are seeing a change in the intensity of rainfall, in particular a sort of Alps type activity is more common and the rainfall totals in such an event are higher, and the implications of these changes are quite serious.

I think what this is causing is increasing level of hazard through time and this is being reflected by increasing levels of impact of those hazards on humans, and it is perhaps little depressing something we need to think about is the fact that at the moment the hazards are increasing rather quicker through time and that suggests all our efforts are much of which is a good work, I think, is not managing to counteract the increasing levels of risk that we are seeing in society. We need to reflect on the fact that we are not achieving our aim at the moment and this seems to me that we need to therefore revisit our work on hazards and to look on detail about what we are doing and how we are doing. It is the concepts that we are using at the moment and the approaches we are using are actually correct and it also questions some of our fundamental concepts and thoughts about the environment and I'm reminded in particular about the way that we adopt. I have done many of these projects myself, and tried to assess these landslide hazards and landslide risks and the first part of that is to generate an approach in which we map out the existing distribution of landslides, use that distribution to come up with some sort of rating-based scheme to assess acceptability, for that approach basically assumed that the distribution of landslides that we see in environment today is representation of landslides that we will see in the future and if we are seeing rapid environmental change as we seem to be seeing that assumption may not be correct, so challenge for us is actually clear. I think we need perhaps to look and refocusing our researches into areas that are relevant to the society and at the moment we may have slight mismatch of times between what the people actually need and what we are actually doing as researchers. I actually disagree with one quite common prominent comment that was made in this meeting, that was a comment that was made yesterday by Dr Glawe and on his talk that he said on his view there is no place on less developed countries for advanced research techniques. I have to say I really disagree with that. I think there is a place for advanced research techniques and we have seen examples in this conference where advanced techniques are giving us real benefit, for examples the work of Mr. Pant who is using advanced geophysical techniques to really give insights into the moraine dams, the movement of water through the groundwater systems, he sink hole generation and evolution of landslides. And, it seems to me that the targeted use for advanced techniques is in order to provide information, but we can then use perhaps in a less concentrated way, is actually some thing that is very important, and I commended advanced research that we see in this meeting, I just like to see it being applied. So, overall, I think the quality of work presented in this meeting is very high. I think it has highlighted some really very important issues and it shows that the general engineering geology and environmental community is making great advances. We must not let our goal down. We have a long way to go, and to maintain that quality is a real challenge in the future. So thank you very much Mr. Chairman for giving me the opportunity for saying these word and in Scottish I will say 'saheli'.

Speech by Professor Dr Jean F. Schneider, Participant from Austria

Thank you, Chairman!

After this scientific resume of Dave, I want to say some personal notes. After 22 years of absence in this country I am very much impressed to be here. After coming back, the extraordinary nature is still the same. Fortunately, the growth of Kathmandu is tremendous, even frightening but the hospitality of the people remained the same and as overwhelming as 22 years ago, really. I am very much impressed about local scientific knowledge, I am impressed about the know-how here, there is a difference between know-how and the knowledge, know-how to do and perhaps collect it on the geology and natural hazards and hydrology and petroleum geology and so on. So for me, it was an excellent possibility here for exchange of this knowledge, also for exchange of know-how. It is a privilege for me to be here in this room and to be here for a few more days in this country and I hope, I really hope, not having to wait another 20 years, or another 22 years to come here. On behalf of all the foreigners, I can speak here: I will say you, just few simple words.

Thank you.

Speech by Professor Gyo-Won Kim, Participant from Korea

Good afternoon Ladies and Gentlemen,

I am delighted to attend the nicely organised **Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation,** also pleased to have opportunity for a brief talk at this concluding session. I will take this opportunity to thank Dr R. P. Bashyal, Convener of this Organising Committee and Dr Tuladhar, President of the NGS, and extend my appreciation to all the members of NGS for their effort in organising this conference. I believe that we had an opportunity to share the knowledge and share practical experience on the engineering geology, share the distinguished papers presented in this conference. Again, I sincerely congratulate the Organising Committee and the NGS for the grand success of this conference. Now, I would like to announce that the next conference, as a continuation of this Fifth Asian Regional Conference, is going to be organised by the Korean Society of Engineering Geology. The sixth Asian Regional Conference (ARC) on geohazards and engineering geology will be held on October 17 to 19, 2007 at Seoul, Korea. Any presentation related to the geohazards and engineering geology is welcome and any other subjects in engineering geology are also acceptable. As the chairperson of the Organising Committee of the Sixth ARC, I look forward to receiving supports from all the attendees of this conference as well as of the IAEG, NGS, and other societies of Asia. The Korean Society of Engineering Geology welcomes all the experts in the field of engineering geology from any part of the world. See you in Seoul, Korea, in 2007.

Thank you.

Speech by Professor A. A. Khan, Participant from Bangladesh

Thank you, Mr. Chairman.

I feel great to be in Kathmandu and I must confess and pay my heartfelt gratitude to the organisers for inviting me here and giving me tremendous traditional hospitality I have received from them is fascinating. This is a very timely taken conference on the engineering geology and geo-hazards mitigation. But, what I would like to request to the esteemed audience that hazards we are facing especially the south Asian and Southeast Asian people is enormous and is multidisciplinary. And therefore, we are facing with various hazards every year. So many people are dying. Now, to be very frank, we are not being able to do anything for the suffered people. This is my personal feeling that our policy-making people or the decision-making people in respective countries are not giving due appreciation to or consideration of the problem. This is the role of the learned people and the genuine geological people to carry this message to the respective planners and policy makers, so that we can do something for the people. One thing, simply we cannot show our muscles to the nature, the will of the nature will do its job. What we can do, we just mitigate, and we can cope up with the nature in order to save ourselves. With these few words, again thank you to the organisers.

Thank you very much.

Best wishes
To
Nepal Geological Society

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Concluding remarks by Dr R. M. Tuladhar, President of Nepal Geological Society

Nameste and good afternoon!

Thank you Dr Bashyal. Distinguished delegates, it is my pleasure to be here once again on the third day of the **Fifth Asian Regional Conference on Engineering Geology and Major Infrastructures Development and Natural Hazards Mitigation**. I have every hope that the deliberations during these three exhaustive days were meaningful, and will be taken into consideration for future implication. Wherever possible, we could clearly see that there are several engineering geological problems faced during and after the construction of infrastructures. This observation calls for future research in the field of engineering geology. There is also an urgent need for natural hazards mitigation, since events of natural disasters are increasing further new areas of potential natural disasters. I hope these newly identified potential natural disasters remain to be great challenge to all global geoscientific community. It is a duty of all fellow delegates to evaluate the performance of this three-day conference; certainly, not me as the president of the Nepal Geological Society.

So far, I have an impression that most of the things went well without any mishaps and I am satisfied with that. Tomorrow, many foreign delegates in particular are going to field excursion to feel practical experience, and I hope you all will enjoy the landscape, the geotechnical complexity, the weather, and the countryside people. We can already see that the Korean Society of Engineering Geology is eagerly waiting for the next conference, and the chairperson of the Organising Committee has also announced to organise the Sixth Asian Regional Conference on 17 to 19 October 2007. That is why while I pass on the conference, I would say a relay band to Professor G. W. Kim, the Chairman of the Organising Committee. First, let me do that.

Finally, I would like to congratulate the Organising Committee, the Convener, the Co-Convener in particular, all the distinguished delegates, all other colleagues, and as our Convener already mentioned, young geologist friends who have been running from here and there, from one corner to other to make this conference a success, who have put their efforts at their level best. Without their support, it would have been impossible to organise such a conference. With these few remarks, I would like to declare the closure of this Fifth Asian Regional Conference.

Wish you all a very good luck.

Thank you.

ARTICLES

News Bulletin of Nepal Geological Society, 2006, Vol. 23, pp. 41–42

Glacial mudflow hazard in Pokhara valley

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Imagine a scenario in Andaman Island in the deadly morning of 26 December 2004. Immediately after the passing of the shaking tremor caused by the Sumatra mega earthquake of magnitude 8.9 the survivor, a local inhabitant could have thanked the spirits for saving his life. But the deadly tsunami waves were on the way to bury the poor man forever. The spirits did not help this time. Does Nepal have to face similar disaster locally? Of course, it is not tsunami but similar earthquake-induced disaster. The case of Pokhara valley is discussed in the following paragraphs.

The Pokhara valley is an intermontane basin in the midland region of Nepal between the High Himalaya and the Mahabharat Range. The valley hosts the Phewa and many other lakes that focus within it the spectacular image of Machhapuchhre summit of the Annapurna range. The beautiful Pokhara city is nestled in the valley and is growing very fast. The valley is situated mainly along the stretch of the Seti River and consists of the Quaternary (younger than one million years) deposits of fluvio-glacial, lacustrine, and alluvial origin. The valley has been a unique place for the study of Quaternary deposits and terraces in the Himalaya that are the key elements to study the geodynamic evolution of the region. Investigators such as Hagen (1969), Sharma (1975), Fort (1979), Gurung (1970), Hormann (1974), and Sharma et al. (1978), studied the Quaternary geology of the valley in 1970s. The group consisting of Yamanaka H., Yoshida M., and Arita K. carried out a multidisciplinary study in 1980s. They mapped the valley and worked out the chronological relation of the Quaternary deposits.

The Pokhara city as well as its peripheral part is located mainly on the terrace of unconsolidated, loose gravel deposit of fluvio-glacial origin which is named as the Pokhara Formation by Yamanaka et al. (1982). The character and distribution of this formation in the Pokhara valley suggests that it has been deposited by catastrophic mudflow along the Channel of the Seti River. Such catastrophic flows were probably episodic and happened due to the slope failure on the southern slope of the Annapurna range. Intensive shaking due to great and large Himalayan earthquakes that occurred in the western Nepal Himalaya could have induced the failure. The fluvio-glacial debris flow could follow the Seti River palaeo channel. Radiocarbon dating of five samples of the Pokhara Formation gives ages between 1360 AD ± 100 years and 880 AD ± 100 years. Actual dates of the mudflow event may differ from individual radiocarbon dating by the uncertainty of age determination and the burial time of source carbon or wood. This is the geological scenario that may be derived from the results of investigation by the above scientists.

Catalogue of historical earthquakes in the Himalaya seems to be complete only for the last 500 years corresponding roughly to 1505 AD. Though devastation has been observed in 1408 AD and 1255 AD in the Kathmandu valley, the absence of data on the regional extent of the devastation prevents the location of the earthquake source and reliable determination of the size or magnitude of the event. We only can say that they were large or great earthquakes with magnitude a little less or greater than 8. Geologically, a large or great earthquake in the Himalaya with magnitude close to or greater than 8 is created when the Indian plate slips to the north below the Himalaya episodically. Such episodic slip occurs along a finite length of the Himalayan arc, the dimension of which depends upon the size of earthquake. A typical earthquake of magnitude 8 may rupture 200 km of length. We do not know which part of the Nepal Himalaya had been ruptured by the events observed in the Kathmandu valley prior to 1505 AD. The youngest mudflow in the Pokhara valley corresponding to 1360 AD ± 100 years may be correlated to 1408 AD and 1505 AD events, considering the uncertainty of age determination and burial time of carbon source or wood. The location and magnitude of 1408 AD earthquake is still unknown. The 1505 AD event that probably ruptured more than 400 km segment of the Himalayan arc lying from the western boundary of Nepal to Gorkha meridian (?) is the greatest known earthquake so far in the Nepal Himalaya. It may have a magnitude greater than 8.3. This event devastated Lo Mustang heavily and could have triggered the youngest glacial debris flow dated as 1360 AD causing a slope failure on the southern slope of the Annapurna range. It is also possible that both these events triggered glacial debris flow along the Seti proto channel. A detailed study will reveal the differentiation.

As there have not been any large or great earthquakes in western Nepal since 1505 AD, the accumulated strain is quite

large enough to cause a great event. In this sense, there is already an overdue of 8.3 magnitude earthquake in this part of the Himalaya. This seismic gap will be filled up by incoming large or great events. However, if one follows certain rules of life, the earthquake risk can be significantly reduced. If we make our houses following the rules and regulations of building codes, our life and property will attain a much higher chance of survival. But let us keep one thing in our mind. We may survive the earthquake shaking but the next moment the powerful mudflow may bury us as well as every thing around below the debris.

What is the possibility of a future mudflow in Pokhara? We only know that earthquakes had generated mudflow in the Pokhara valley in the past and there could be any time a great earthquake in western Nepal. In the last 500 years drainage, climate, vegetation and settlement pattern have changed along the Seti channel. Glaciers in the southern slope of the Annapurna range have also been changed. Hazard assessment taking into account all the involved factors causing the disaster would allow assessing the risk, mapping the vulnerable area, and recommending adequate measures of risk reduction.

News Bulletin of Nepal Geological Society, 2006, Vol. 23, pp. 43–46

Engineering geological characteristics of Matatirtha debris flow, Kathmandu

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ABSTRACT

In the last week of July 2002, a heavy rainstorm triggered more than 50 shallow landslides and debris flows in the southwestern outskirts of the Kathmandu valley. The Matatirtha debris flow is one of them. It occurred on the night of 23 July 2002 at the Gairigaun village of the Matatirtha VDC. It destroyed 6 houses and took 18 lives. This paper gives an overview of the debris flow. Weathered limestone is found as bedrock containing four sets of discontinuity. The debris consisted of colluvial soil ranging between GM–GC and SM–ML with a considerable amount of gravel. The volume of displaced material was estimated at 27,300 m^3.

INTRODUCTION

Landslides and debris flows are the most common types of hydrological disaster in the mountainous region of Nepal. Such disasters are frequently related to deeply weathered colluvial soils and high groundwater tables during the monsoon period.

Between 1983 and 2002, the mean annual death rate due to hydrological disasters was 328 people. During the same period, 31,600 families were affected annually by the disasters and property worth of more than NRs 707 million was lost. In the last week of July 2002 alone, 24 people were killed, 9 were injured, and 23 houses were destroyed in the Kathmandu district (DWIDP 2004). More than 50 landslides were triggered in the hillslopes of southwest Kathmandu in the same week. The Matatirtha debris flow was one of them, which occurred on the night of 23 July.

The Matatirtha debris flow is located at the Gairigaun village of the Matatirtha VDC in the Kathmandu district. It lies about 3 km south of Satungal, between 85°13'22" and 85°13'53" E longitude and 27°40'18" and 27°40'21" N latitude (Fig. 1). The Seti Devi Khola flows through the toe of the debris flow. Its head escarpment and zone of depletion lie in the dense mixed forest and bush land, while the displaced debris is deposited on the cultivated land (Fig. 2). Six houses were buried and eighteen persons were killed by the debris flow. Three houses and one school were also partially damaged.

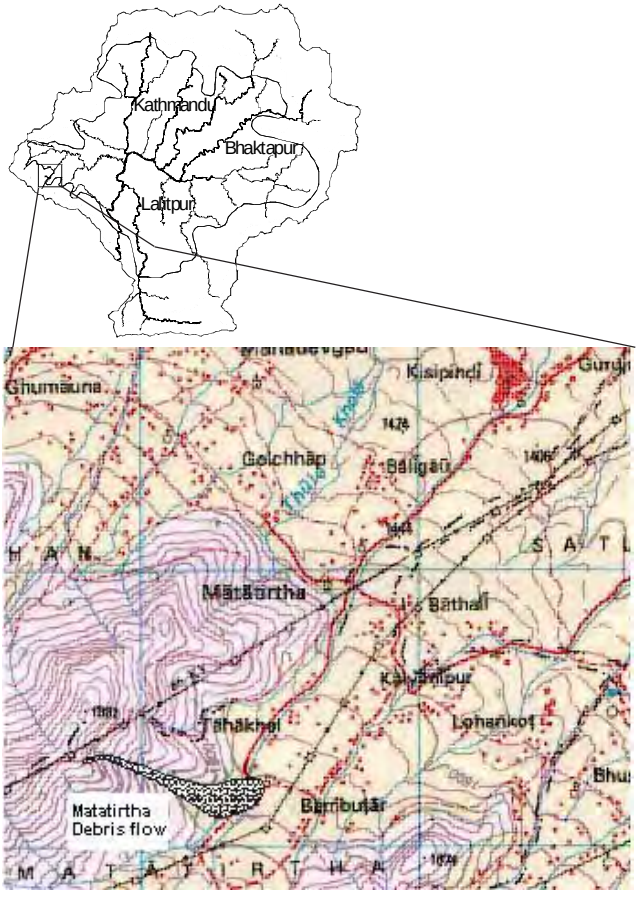


Fig. 1: Location map of the study area

Fig. 2: Photograph showing the Matatirtha debris flow at Gairigaun (view towards the west)

Precipitation data obtained from the nearby Thankot meteorological station showed an intense rainfall from 20 to 25 of July 2002 (Fig. 3). A 24-hour maximum rainfall of 300.1 mm was recorded on 23 July when the debris flow occurred.

MORPHOLOGY OF DEBRIS FLOW

The debris flow exhibits an elongated shape (Fig. 4). It is about 580 m long, 15–110 m wide, and 2–8 m deep having an area of about 6350 m^2. The upper part of debris flow zone is narrow (15–30 m wide) and forms an active gully facing N70°E.

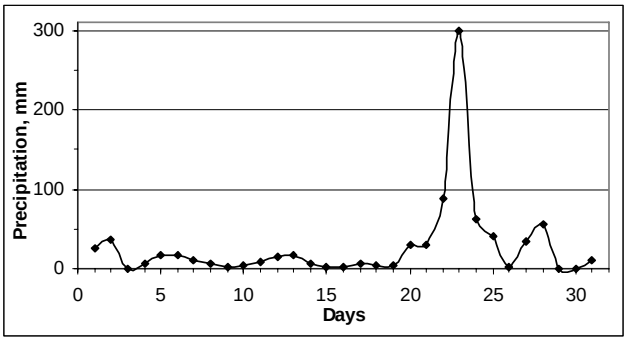


Fig. 3: Precipitation recorded at Thankot (station no. 1015) in July 2002 (DHM 2005)

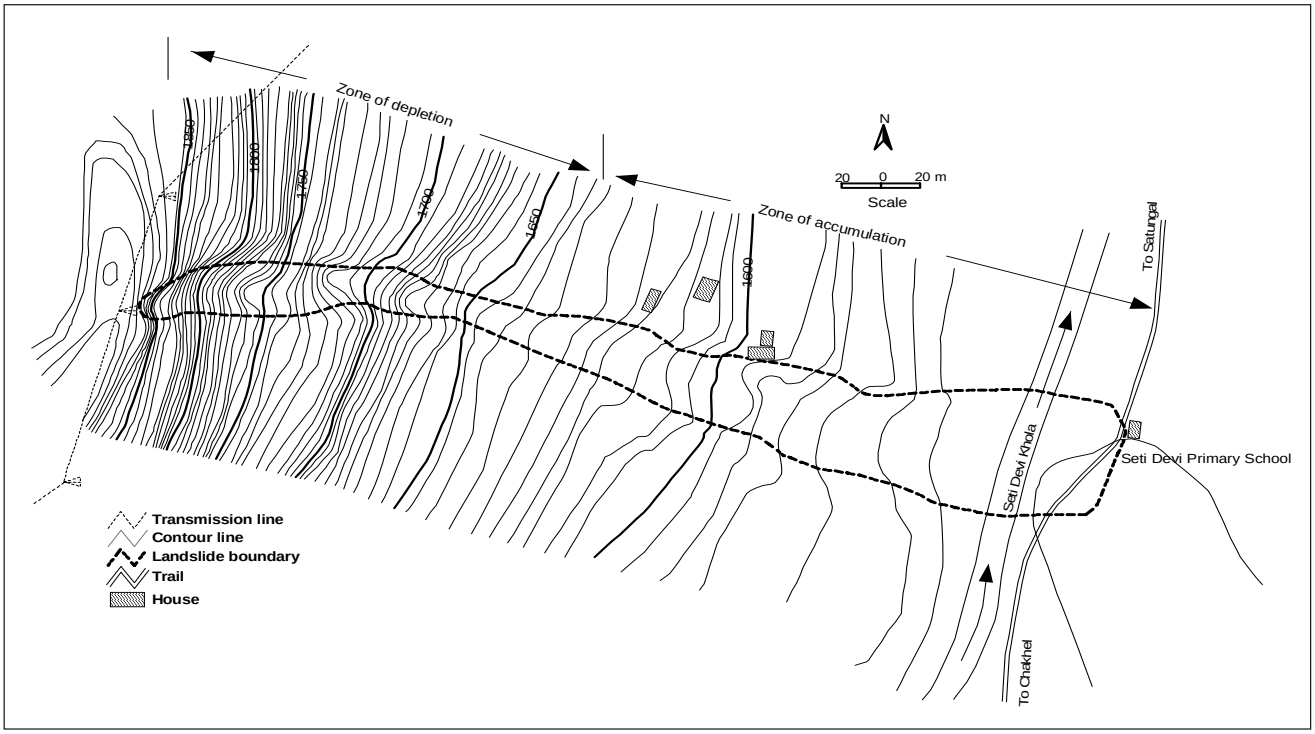
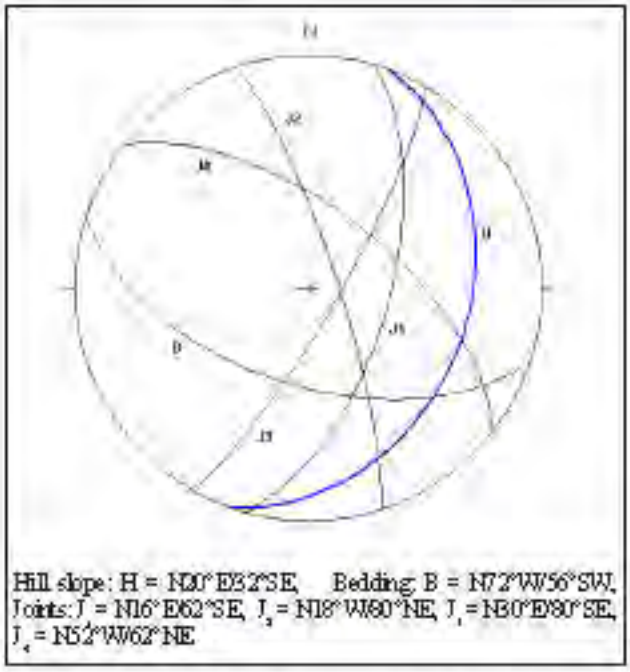


Fig. 4: Topographical map of the Matatirtha debris flow (after Dahal and Kafle 2003)

Fig. 5: Partially damaged school by debris flow



Hill slope: H = N30°E32°SE, Bedding: B = N72°W56°SW, Joints: J_1 = N16°E62°SE, J_2 = N18°W80°NE, J_3 = N30°E80°SE, J_4 = N52°W62°NE

Fig. 6: Lower hemispherical projection of discontinuities in limestone

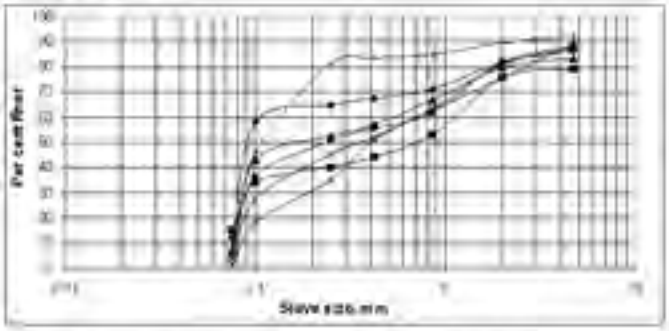


Fig. 7: Grain size distribution curves of debris

The lower portion is gentle and wide (80–110 m), and faces S72°E forming a small debris fan (Fig. 4).

There is a landslide zone in the upper reaches of the debris flow. It has multiple scarps of about 280 m long and situated between 1725 to 1870 m. Its main scarp is more than 60 m high. Several cracks were observed at the crown and many transverse cracks were developed on the right flank of the landslide. These cracks are 10–15 m long, 2–5 cm wide, and dip towards the east. Similarly, several minor scarps were observed on either flank in the zone of depletion. The zone of accumulation of debris flow is about 300 m and its tip is at an altitude of 1565 m. The slope gradient of landslide and debris flow varies from 15–45° in the upper reaches to less than 10° in the zone of accumulation.

The Seti Devi Khola flows through the toe of the debris flow. The debris flow temporarily dammed the stream and hit Seti Devi Primary School situated on the opposite (right) bank of the stream (Fig. 5). Subsequently, the dam was breached. Within the debris flow zone, the stream is about 25 m wide and 12 m deep.

ROCK AND SOIL

The upper reach of the Matatirtha debris flow consists of the Chandragiri Limestone of the Kathmandu Complex (Stöcklin and Bhattarai 1977). These yellow to brown, weathered, massive limestone beds are highly jointed and contain soft slate partings, especially in the failure zone. The beds are dipping southwest and contain four joint sets (Fig. 6). The lower reach of the debris flow lies in thick colluvium.

The debris is composed mainly of brown to reddish brown, completely weathered colluvial soil. Limestone boulders of up to 2 m in diameter are predominant.

The crown of landslide zone is covered by a thin (less than 50 cm) soil layer, which becomes about 5 m thick at the end of the zone of depletion. According to the Unified Soil Classification System, the soil ranges between GM–GC and SM–ML with a considerable amount of gravel (Fig. 7). The plastic limit of the soil samples collected from various locations ranges from 20 to 30%, whereas their liquid limit varies from 25 to 45%. Almost all the plots of plastic limit and liquid limit lie below the A-line on the Casagrande Plastic Limit Chart (Fig. 8). Their specific gravity ranges from 2.5 to 2.79. These index properties indicate a dominance of sand and inorganic clay with a very little amount of organic clay in the colluvium. The dry unit weight of the soil ranges between 15 kN/m^3 and 19 kN/m^3. Similarly, the shear strength test carried out on reconstituted samples gave the friction angle values between 25° and 30° (Thakuri et al. 2003).

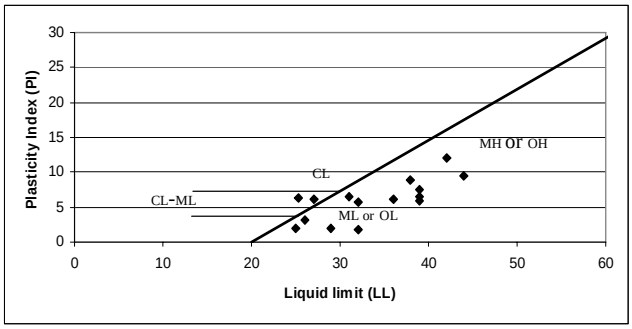


Fig. 8: Plot of liquid limit and plasticity index in plasticity chart

VOLUME ESTIMATION

An approximate volume of the debris flow deposit (V) was estimated using the equation of WP/WLI (1990):

$$V = \frac{1}{6}\pi D_d W_d L_d$$

where

D_d = Maximum depth of displaced mass measured perpendicular to plane containing Wd and Ld

W_d = Maximum breadth of displaced mass perpendicular to length, Ld

L_d = Minimum distance from the tip (at the toe of debris flow) to top (at the main landslide scarp).

For the Matatirtha debris flow, D_d, W_d, and L_d were 3.5 m, 50 m, and 300 m, respectively. Hence, its maximum volume of displaced material was about 27,300 m^3.

CONCLUSIONS

The Matatirtha debris flow lies on highly jointed and weathered limestone covered by colluvium. The debris flow occupies an area of about 6350 m^2 and its volume of displaced material is about 27,300 m^3. The debris flow was initiated by a torrential rainfall of 300.1 mm in 24 hours. Its right flank is more hazardous owing to the presence of transverse cracks. Presently, the Seti Devi Khola is undercutting the debris flow deposit and creating sedimentation problems in the lower reaches.

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News Bulletin of Nepal Geological Society, 2006, Vol. 23, pp. 47–49

Integration of spatial data based on map overlays in GIS for landslide hazard analysis

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INTRODUCTION

A variety of techniques have been developed to analyse landslide hazard. They can be grouped into the inventory, heuristic, statistical, and deterministic approaches (Soeters and van Westen 1996, van Westen et al. 1997, Atkinson and Massari 1998). Most proposed methods consider that the geomorphic and geological variables of future landslides should be similar to those conditions leading to past and present slope movements, together with the identification and mapping of the conditioning or preparatory factors of slope instability, which are the keys in predicting future landslides (Carrara et al. 1998).

Recently, the integration of spatial data covering a variety of digital products, ranging from base maps with topography and infrastructures to special thematic maps, is increasingly used for landslide hazard assessment by Geographic Information System (GIS). The GIS is a powerful tool, which combines various maps in the spatial database to compute landslides hazard.

OVERLAY OPERATION AND VARIABLE ACQUISITION

In a GIS overlay operation, the layers with a common, registered map base are joined on the basis of their spatial distribution. The overlay function creates composite maps by combining diverse datasets (Fig. 1). Raster and vector models differ significantly in the way overlay operations are implemented. Overlay operations are usually performed more efficiently in raster-based systems. A hybrid approach is used that takes advantage of the capabilities of both data models. A vector-based system may implement some functions in the raster domain by performing a vector-to-raster conversion on the input data, doing the processing of a raster operation, and converting the raster result back to a vector file.

The variables for derivation of landslide hazard analysis consist of various thematic maps acquired from different sources (Table 1). The basic data layers produced from the GIS include landslide inventory and variables responsible for causing slope failures. A landslide inventory map is prepared and attribute data are assigned to individual landslides to describe quantitatively the relationship between landslides and their causative factors. Landslide conditioning variable maps are obtained as derivative layers by spatial analysis or digitised layers of field surveyed maps.

A Triangulated Irregular Network (TIN) model is created from a digital topographic map of 1:25000 scale, which is used to generate a Digital Elevation Model (DEM) at a resolution of 10 x 10 m grid size. The DEM is utilised to produce various derivative layers, such as slope angle and slope aspect. Drainage lines are extracted from the DEM using a hydrological model, and the Strahler classification function is used to rank the stream orders.

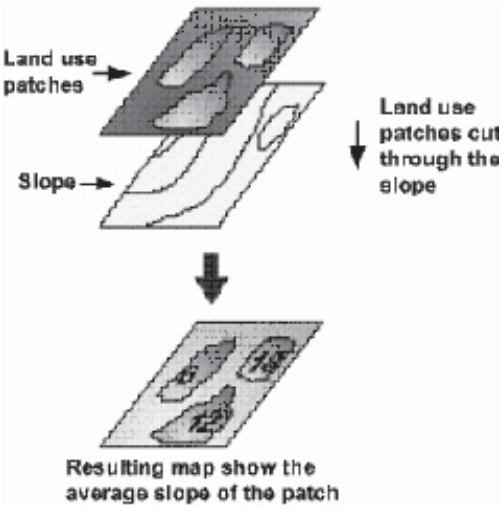

Fig. 1: GIS process of overlay operation to derive spatial database

Table 1: Data layers for GIS analysis

Classification	Coverage	Spatial data type	Attribute data type
Geological hazard	Landslide	Polygon	Nominal
Damageable object	Road, building	Point, polyline	Nominal
Basic map	Topography	Point, polyline	Nominal, interval
	Geology	Polygon	Nominal
	Eng. geology	Polygon	Nominal
	Land use	Polygon	Nominal
Hydrological data	Precipitation	Point, polyline	Nominal, interval

All thematic vector layers are rasterised for analytical purposes and a grid resolution of 10 m is utilised to fully exploit the detailed geomorphic information. The grid format is considered optimum for this kind of process, as the sizes of the smallest landslide represented in the analysis format is 10 m. The rasterisation of linear elements is done by creating an appropriate buffer around the linear features. Continuous variables are transformed into discrete classes with reclassification criteria based on the need to have a limited number of classes, which adequately represent a wide range of original categories in each class.

A landslide inventory map is converted to a 10 m grid file. Each cell is assigned ''0'' if no landslide is present or ''1'' if a landslide is present, and a ''no data'' code is assigned if the cell is outside the study area. The landslide grid file and causative variable grid files are logically compared to ensure that they cover a common area. All landslide-bearing pixels are used to extract automatically from the existing data layers the physical parameters that characterise landslide locations. A base map of point features with 10 m interval is prepared from the raster layers. An algorithm is executed to extract the pixel values from all raster layers of causative variables to the point layer. Thus, all attributes extracted are stored in a point base map file indicating the presence or absence of landslides. The spatial design for analysis is represented by mapping units called 'slope units'. The slope units are automatically identified in the entire watershed from DEM by hydrological analysis using Arc Hydro Tool of ESRI and Slope Unit Tool (Esaki et al. 2004).

LANDSLIDE HAZARD ANALYSIS

The acquired variables are integrated to assess landslide hazard. The variables analysed include terrain, rock and soil types, and other causative factors linked to slope failures. The variables are entered in the model from different sources and two categories of variables are defined:

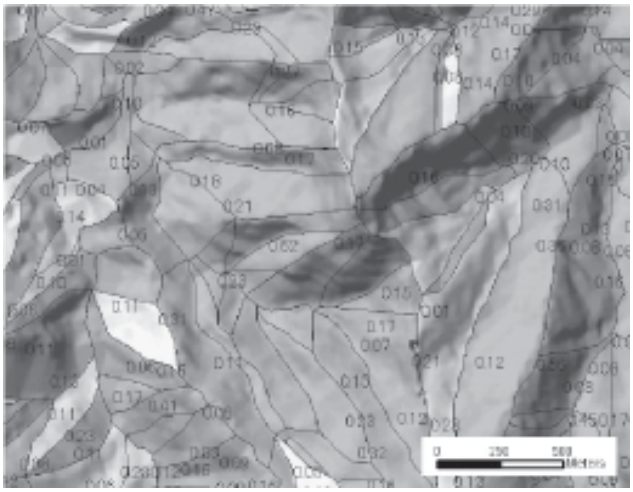

Fig. 2: An illustration of numerical probability value based on logistic regression coefficient in slope units

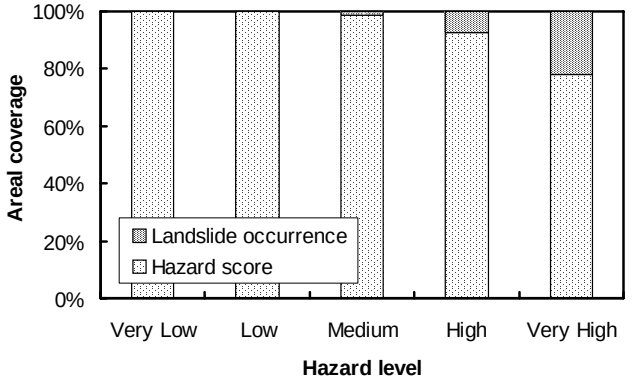

Fig. 3: Validation of hazard map by using occurrence of past landslide event (Esaki et al. 2005)

- Derived from DEM (elevation, slope angle, slope aspect, drainage) and
- Not derived from DEM (lithology, engineering geology, land use).

Using the overlay capabilities of the GIS, the attribute data are georeferenced to slope units. An important aspect of hazard analysis is the conversion of various nominal parameters (i.e. lithology, land use) to numeric format through the creation of a dummy variable matrix. The matrix is then exported to a statistical analysis program (such as SPSS 1997) for analysis. For example, in SPSS, the technique of logistic regression yields coefficients for each variable based on derived data taken across the study area. These coefficients serve as weights in an algorithm, and they are used in the GIS database to produce a map depicting the probability of landslide occurrence (Fig. 2).

The landslide hazard map generated from the analysis is classified into different levels of hazard. The hazard levels are categorised into very low, low, medium, high, and very high using natural junk break method and overlaying of past landslide map for the adjustment of class boundaries.

The predicted results are validated with respect to the future landslide hazard by map crossing between the predicted hazard map and the landslides of past events on raster maps. For example, the calculated and classified hazard levels in the Agra Khola watershed of central Nepal are found in a good agreement with the occurrence of pre-existing landslides, because in this watershed higher hazard levels were found in the areas with a greater landslide frequency (Fig. 3). The validation is useful not only to determine the predictive value of maps, but also to improve different steps in hazard map-making process.

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News Bulletin of Nepal Geological Society, 2006, Vol. 23, pp. 50-53

Landslide hazard on the Kanti Rajpath, central Nepal

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ABSTRACT

This paper focuses on the geology and distribution of landslides on the Kanti Rajpath. The road passes through the Siwaliks between Hetauda and the Bagmati River, and then it runs through the rocks of the Nawakot Complex and Kathmandu Complex. There are minor landslides between Hetauda and Thingan, but about 10km long stretch between Thingan and Kalche is highly vulnerable to sliding. The Main Boundary Thrust and the Mahabharat Thrust are encountered there. The road is moderately hazardous between Kalche and Bhattedhanda, whereas after Bhattedanda, it is relatively less hazardous.

INTRODUCTION

The road alignment of Kanti Rajpath starts in Hetaunda, and ends at Km 86+277 m at Chapagaun, Lalitpur, in the Kathmandu valley (Fig. 1). The area comprises the rocks belonging to the Kathmandu Complex, Nawakot Complex, Siwaliks, and Quaternary deposits. The Kathmandu Complex is thrust over the Nawakot Complex along the Mahabharat Thrust (MT), whereas the Lesser Himalayan Nawakot Complex is thrust over the Siwaliks along the Main Boundary Thrust (MBT).

QUATERNARY DEPOSITS

The road alignment begins with the Quaternary deposits at Hetauda and continues through them up to Chandanda (Km 09 + 000 m). They are represented mainly by recent fluvial terrace deposits of the Karra Khola. Some old terrace deposits and lacustrine deposits are also present at the other end of the road alignment in the Kathmandu valley (Fig. 1).

SIWALIK GROUP

The Siwalik Group crops out between Chandanda and Ratmate (Fig. 1). It forms gently dipping hills covered by colluvial and residual soils. Generally, the south-facing slopes are more rugged than the north-facing ones. The Siwaliks are represented by a thick pile of fresh-water sediments. Soft, feeble and loose sandstones, mudstones, and conglomerates constitute the main lithology of the Siwaliks.

The Lower Siwaliks crop out between Chandanda and Adheri. The main rock type is thickly bedded, variegated mudstone (red-purple to blue-grey) with occasional thin-bedded, fine-grained sandstone. The Middle Siwaliks are exposed between Adheri and Thingan. Their main lithology is thickly bedded sandstone intercalated with thinly bedded mudstone. Some pebbly sandstone beds are present in the upper portion of the Middle Siwaliks. The Upper Siwaliks crop out between Tingan and the Khahare Khola at Ratmate. The dominant lithology is thinly bedded sandstones intercalated with conglomerates.

The MBT is observed in the Khahare Khola in the vicinity of Ratmate. It is marked by about 500 m thick crush zone with

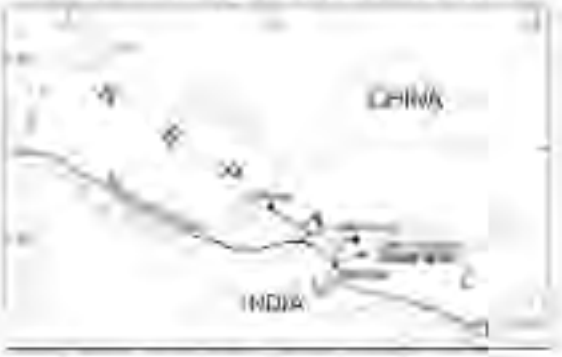

Fig. 1: Location map of the study area

dark grey to black fault gouge and grey colluvial soil. The area is extremely vulnerable to gully erosion and slope failures.

UPPER NAWAKOT GROUP

The Benighat Slates belonging to the Upper Nawakot Group crop out in the hanging wall of the MBT. The slates cover about 2 km of the road alignment between Ratmate and Bhariyadanda. They are dark grey to black in colour, and are feeble and highly cleaved. They constitute a gentle topography with grey to brown colluvial soil. The thin- to thick-bedded, yellow coloured and jointed Jhiku carbonate beds are exposed from Bhariyadanda to Saktedandagaun.

KATHMANDU COMPLEX

The Kathmandu Complex overlying the Nawakot Complex is separated by the MT, which is exposed at Saktedandagaun. The Kathmandu Complex occupies the entire area between Saktedandaguan and Charghare of the Lalitpur district and covers about 35 km of the road stretch. It is represented by a rugged topography with rather steep slopes and is subdivided into the Bhimphedi Group and the overlying Phulchauki Group (Stöcklin and Bhattarai 1977). The grade of metamorphism in the Kathmandu Complex decreases gradually from bottom to top. Consequently, the rock succession belonging to the Bhimphedi Group consists of garnetiferous schists, marbles, and quartzites, whereas that of the Phulchauki Group is made up of phyllites, slates, sandstones, shales, and limestones.

Bhimphedi Group

The Bhimphedi Group occupies the area between Saktedandagaun and Kotdanda. It is further subdivided into the following formations from bottom to top, respectively.

The Raduwa Formation consists of garnetiferous schist and quartzite.

The Bhainsedhovan Marble is composed of coarse crystalline, light coloured marble with intercalations of thinly bedded dolomite.

The Kalitar Formation is represented by garnetiferous schist, micaschist, and micaceous quartzite. The quartzite is thin- to thick-bedded, dark green-grey coloured and highly jointed. The grain size in garnetiferous schist gets smaller towards the upper portion of the formation.

The Chisapani Quartzite consists of a continuous band of thin- to thick-bedded, fine-grained, white quartzite.

The Kulikhani Formation is composed of fine-grained micaceous and quartzose schist, which varies in proportion from place to place. The quartzite is grey, thin- to thick-bedded, moderately weathered, and jointed. A granite intrusion (about 7 km) covers most part of this formation along the road alignment

The Markhu Formation is represented by thin- to medium-bedded, fine-grained grey quartzite alternating with massive, yellow carbonate beds and phyllites. Quartzite is the dominant rock type of this formation.

Phulchauki Group

The Phulchauki Group occupies the area between Kotdanda and Charghare. It is further subdivided into the following formations, respectively in an ascending order.

The Tistung Formation is the lowermost unit of the Phulchauki Group and comprises interbedded sandstone and shale. The sandstone is thin-bedded, weathered, fine-grained and grey in colour.

The Sopyang Formation is composed of interbedded slate, phyllite, and limestone. The phyllite and slate are highly weathered and the limestone is sporadically exposed.

The Chandragiri Limestone is the topmost formation of the Phulchauki Group in the study area. This formation is represented by weathered and massive yellow to brown limestone. In fresh outcrops, the limestone is finely crystalline, poorly silicious, and partly dolomitic.

Intrusive rocks

Though there are minor intrusives (i.e. amphibolites and pegmatites), the Narayanthan Granite is the main igneous rock body of the study area. It is intruded in the Kulikhani Formation and constitutes steep and rugged topography with large boulders (more than 1 m in diameter) scattered on the riverbed as well as gentle hill slopes. It is represented by coarse-grained feldspar, quartz, muscovite, and biotite with tourmaline as an accessory mineral. It is massive and sparsely jointed and slightly foliated, especially at the contact zone with the country rock. There are numerous crosscutting quartz veins (of at least three generations) in the granite and the country rock surrounding it.

ENGINEERING GEOLOGY OF ROAD ALIGNMENT

Detailed field investigations were carried out throughout the road alignment for the purpose of assessing its landslide hazard as well as rock and soil type, slope angle, soil depth, types of discontinuity, and rock weathering grade. The engineering geological map (Fig. 2) of the road alignment shows the soil and rock type, geological structures, and stereographic representations of some major landslides. In the study area, hillslope vary from below 15^{o} (terrace deposit) to more than 45^{o} (near Jhakridada). The topography is even

Fig. 2: Engineering geological map of Kanti Rajpath

Fig. 3: Landslide at MBT (Km 46+100 m)

Fig. 4: Landslide at Kalche

and gentle (15° – 30°) in the Siwaliks, whereas it is uneven and steep (40° to more than 45°) in the crystalline rocks. Joints are also prominent in the crystalline rocks (Fig. 2). Residual soils are observed in some places having yellow, brown and red colours. Their depth ranges between less than 1 m to more than 3 m.

Landslide hazard

According to Varnes (1984), hazard means the probability of occurrence within a specified period of time and within a given area, of a potentially damaging phenomenon. Landslide hazard is controlled by several factors such as natural slope, geology, soil type and depth, rills and gullies, land use, drainage pattern, groundwater conditions, erosion, and unfavourable dipping of rock strata. The MBT and MT are other major structures controlling the landslide hazard.

The area is highly hazardous between Thingan and Kalche. At Thingan, the road descends on a gentle slope (< 25°) and encounters the MBT (Fig. 2), which has a wide crush zone (Fig. 3). Two major landslides are present near the confluence of the Mahadev Khola and Chausur Khola, at Mahadevtar. Weathered colluvial deposit is present on the right bank of the Bagmati River. The road section through the colluvium is highly vulnerable to failures. The largest landslide on the road is encountered at Kalche (Fig. 4). About 500 m north of Kalche, there is another major landslide on weathered quartzite and schist. The main causes of failure are steep slope (45°), presence of highly to completely weathered schist and quartzite, and the occurrence of springs at the crown of the landslide.

DISCUSSIONS AND CONCLUSIONS

Soft sandstones and mudstones as well as conglomerates of the Siwaliks, slates, schists, marbles, quartzites, and granite of the Nawakot and Kathmandu Complexes, and Quaternary sediments of Hetaunda and Kathmandu valleys are found on the road between Hetauda and Chapagaun.

About 30% of the road alignment is highly vulnerable to failures owing to the presence of more than two sets of joint, highly weathered nature of rocks, presence of MBT and MT as well as other fractures, cleavage planes, small-scale folds, and faults. Large landslides are present at Gairigaun, Ratmate, Bhariyadanda, Mahadevtar, Kalche, and Jharidanda. Such landslides are difficult to control.

Monsoon rain is one of the main landslide triggers. For example, the cloudburst of 1993 triggered or reactivated a number of mass movements. Similarly, groundwater is also another important factor, as the mass movements are confined to concave slopes and river valleys.

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News Bulletin of Nepal Geological Society, 2006, Vol. 23, pp. 54–65

नेपालको भौगर्भिक संरचना र बाढी-पहिरोको सम्बन्ध

मेघ राज धिताल

भू-गर्भशास्त्र केन्द्रीय विभाग, त्रिभूवन विश्वविद्यालय,
कीर्तिपुर, काठमाडौं, नेपाल

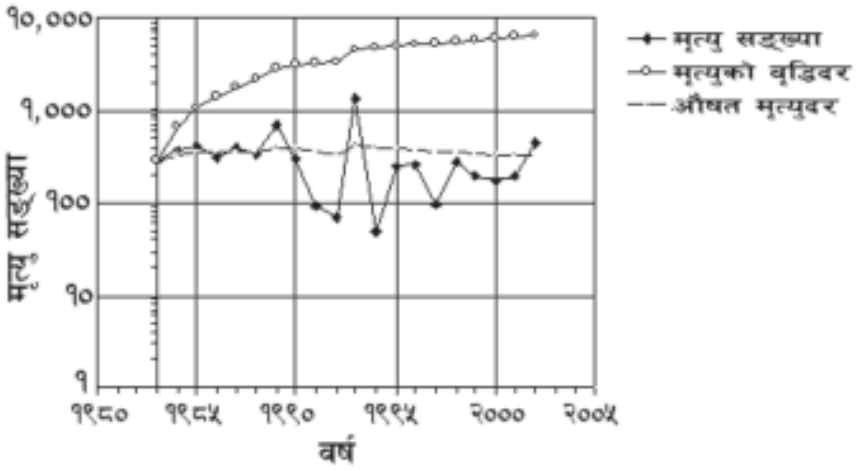
पृष्ठभूमि

नेपाल प्रत्येक वर्ष प्राकृतिक प्रकोपको ठूलो चपेटामा पर्दछ। वर्षायाममा यहाँका गाउँघर, डाँडा-पाखा र खोलाका किनारमा पहिरो जान्छ, तराई क्षेत्रमा बाढीले उत्पात मच्चाउने गर्दछ (चित्र १)। त्यसैगरी, समय-समयमा जाने भुइँचालोबाट पनि कम क्षति पुग्दैन। अर्कोतर्फ, हिमपहिरो र हिमताल विस्फोटको खतरा पनि उत्तिकै पीडादायी र विनासकारी देखापर्दछन्। यस्ता प्राकृतिक प्रकोप कुनै न कुनै रूपमा यहाँको भौगर्भिक बनोट र भौगोलिक अवस्थितिसँग सम्बन्धित हुन्छन्। भौगर्भिक संरचना र हावापानी, तापमान, वर्षा र वायुजस्ता बाह्य कारकतत्वहरूको सामुहिक प्रभावका कारण विभिन्न प्राकृतिक प्रकोप जन्मन्छन्। यसमा पनि मानवजन्य क्रियाकलापले तिनका जोखिम र त्यसबाट उत्पन्न समस्यालाई अझै जटिल र गम्भीर बनाउँछन्। वास्तवमा प्राकृतिक प्रकोप शैलमण्डल, जलमण्डल, वायुमण्डल र मानवसमाजबीचको अन्तर्क्रियाको उपज हो। यस लेखको मूख्य उद्देश्य भौगर्भिक संरचना र प्रकोपका सम्बन्धमा प्रकाश पार्नु रहेकाले त्यसैमा केन्द्रित रही अन्य कारकतत्वमाथि सामान्य छलफल मात्र गरिनेछ।

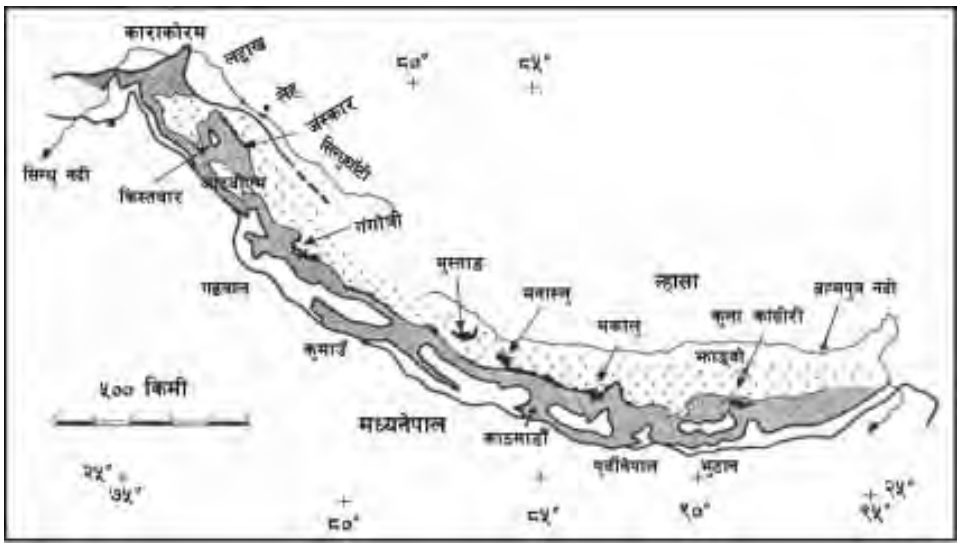
नेपालको भौगर्भिक संरचना

करिब २४०० किलोमिटर लामो चन्द्रकार हिमालय पर्वत शृङ्खलाको केन्द्रमा अवस्थित नेपालको भौगर्भिक संरचना (चित्र २) पनि हिमालयका अन्य भागहरूसँग मिल्दोजुल्दो छ। हिमालयका अन्य भागहरूझैं नेपालको भू-भागलाई पनि विभिन्न समुहमा (चित्र ३) विभाजन गर्न सकिन्छ। यी संरचना (चित्र ४) क्रमैसँग दक्षिणबाट उत्तरसम्म निम्नानुसार रहेका छन्।

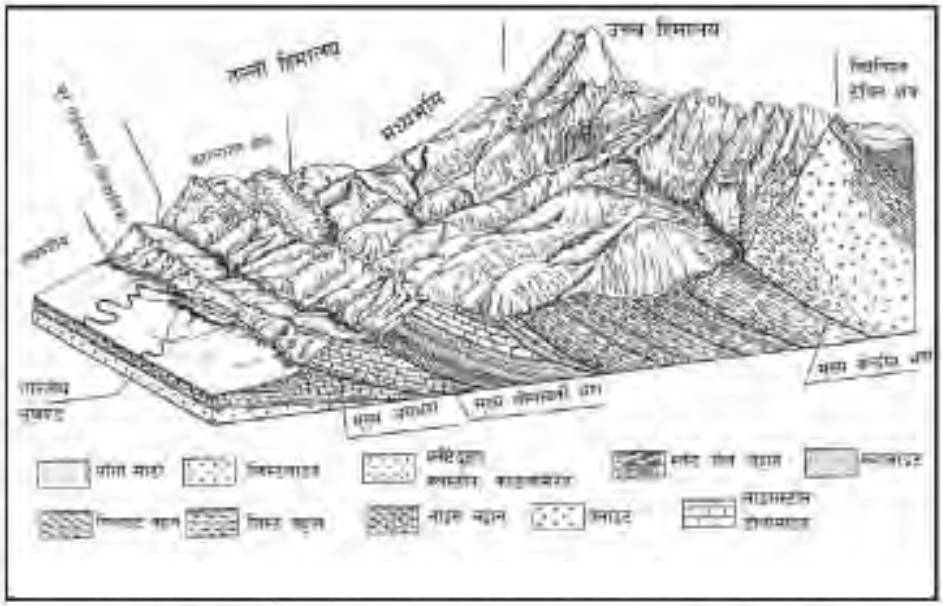
तराई प्रदेश : यो क्षेत्र हिमालयको दक्षिणपट्टि समुद्रसतहदेखि करिब १०० मिटरसम्मको उचाइमा (चित्र ४) अवस्थित छ। नेपाल तथा तिब्बतमा उत्पत्ति भई बग्ने करिब ६ हजार नदीनालाले थुपारेको नरम माटोको परतले तराईक्षेत्र बनेको छ। पहाडबाट तीव्र गतिमा बग्दै आएका नदी र खोलाको बहावमार्गको भिरालोपन एकाएक घट्न जाँदा बगाएर ल्याएको ढुङ्गामाटो यस क्षेत्रमा थुप्रन्छ। समतल स्थानमा बग्ने भएकाले यहाँका नदी र खोला नागबेली आकारमा बग्ने गर्दछन्। वर्षायाममा बाढीले यसै क्षेत्रमा अत्यधिक क्षति पुऱ्याउने गर्दछ।



चित्र १: गत बीस वर्षमा नेपालमा बाढीपहिरोबाट मृत्यु हुनेको सङ्ख्या र वृद्धिदरको अवस्था



चित्र २ : चन्द्राकार हिमालयपर्वत शृङ्खला र विभिन्न चट्टानहरूको अवस्थिति (Pêcher 1991)

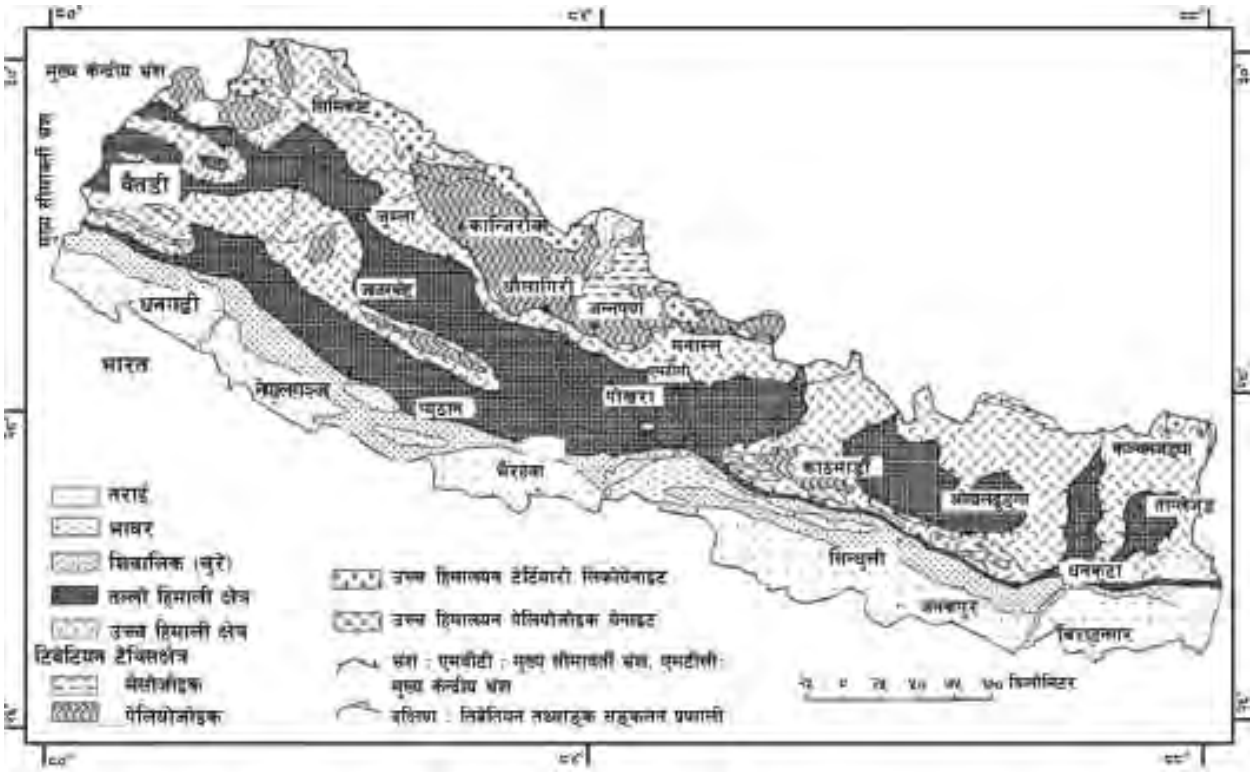


चित्र ३ : नेपालको सरलीकृत भौगर्भिक संरचनाको तीन आयाम चित्र (Deoja et al. 1991)

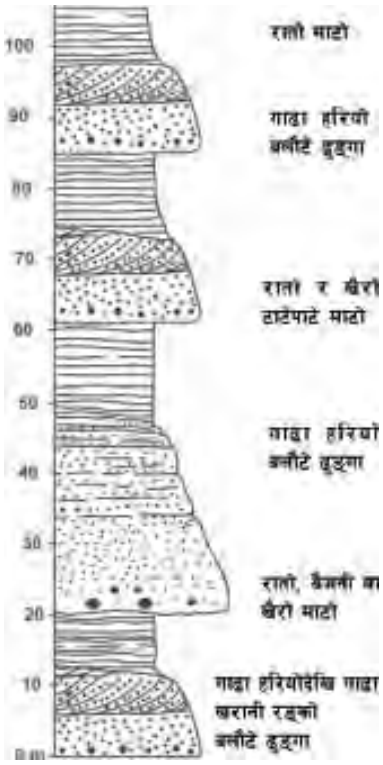
चुरे शृङ्खला : चुरे पर्वतमाला (चित्र ३ र ४) तराईको उत्तरी सिमानामा जोडिएको छ। यसको पश्चिमबाट पूर्वतिर क्रमशः घट्दै गएको उचाइ सालाखाला १, ५०० मिटर रहेको छ। यसको चौडाइ पनि पश्चिमबाट पूर्वतर्फ नै घट्दै गएको छ। यहाँ पाइने चट्टान नरम र खुकुला छन्। चुरे क्षेत्रमा पाइने चट्टानलाई मूख्यतया निम्न तीन वर्गमा विभाजन गर्न सकिन्छ

निम्न शिवालिक चट्टान : यो चट्टान रातो माटो र गाढा हरियो तथा गाढा खरानी रङका बलौटे ढुङ्गाले बनेको हुन्छ। एक चट्टानको परतको मोटाइ ५ मिटरदेखि २५ मिटरसम्मको हुन्छ। यी दुई प्रकारका चट्टान (चित्र ५) भूगर्भको एक निश्चित गहिराइसम्म क्रमशः दोहोरिइरहन्छन्।

मध्य शिवालिक : मध्यशिवालिक चट्टान मूख्यतया 'नुन-मरिच' वा 'तिल-चामल' जस्तो कालो, सेतो रङका बालुवाका कण र सेतो, गाढा खरानी वा कालो माटोको परतले बनेको हुन्छ। एउटा चट्टानको परतको मोटाइ २० देखि ४० मिटरसम्म रहेको पाइन्छ। यस चट्टानले ठाडा भीरपाखा र पहरा बनाएको हुन्छ।



चित्र ४ : नेपालको सरलीकृत भौगर्भिक नक्सा



चित्र ५ : निम्न शिवालिकको परत-विन्यासको एक नमुना

उच्च शिवालिक चट्टान : उच्च शिवालिक चट्टान गेगरको सङ्गुटिकाश्मले बनेको हुन्छ । सङ्गुटिकाश्मको बीचमा पहेंलो, खैरो र रातो माटोको परत पनि हुन्छ । यो खुकुलो भएकाले यसबाट निस्कने खोला र खोल्साहरूमा गेगर ढुङ्गा प्रशस्त पाइन्छ । प्रायः यस्ता खोल्सा सुख्खा भए पनि वर्षायाममा यहाँ ठूलै बाढी र लेदो (Debris flow) आउने गर्दछ ।

पहाडबाट खोलानालाले बगाएर ल्याएको पाँगो माटो, बालुवा र गेगर तराई र भावरक्षेत्रमा थुप्रिएर त्यहाँको भूसतहको संरचना भएजसरी नै माथि उल्लेखित सबै शिवालिक चट्टान कुनै कालमा बनेका हुनुपर्दछ । त्यस्ता चट्टानमा वनस्पति र जीवजन्तुका अवशेष प्रशस्त पाइन्छन् ।

शिवालिक पर्वतमालामा भित्री मधेश अथवा दून उपत्यकाहरूसमेत रहेका छन् । हेटौंडा, चितवन, दाङ, देउखरी र सुर्खेत उपत्यका चुरे तथा शिवालिकक्षेत्रमा अवस्थित मूख्य उपत्यका हुन् ।

निम्न हिमालय

चुरे पहाडको उत्तरतर्फ र उच्चहिमाली क्षेत्रको दक्षिणतर्फ अवस्थित यस भू-भागलाई महाभारत पर्वत शृङ्खलाका रूपमा चिनिन्छ । ७५ देखि १२५ किलोमिटर चौडा रहेको अग्ला-होचा पहाड, साँघुरा उपत्यका, बेंसी, टार र पाखा भएको यो क्षेत्र समुद्रसतहदेखि करिब २,००० मिटरसम्मको उचाइमा रहेको छ । भौगर्भिक संरचनाअनुसार निम्नहिमालय क्षेत्रलाई मोटामोटीरूपमा दुई भागमा बाँड्न सकिन्छ ।

महाभारत शृङ्खला : शिवालिक अथवा चुरेपर्वतमालासँग सिमाना जोडिएर रहेको महाभारत पर्वतमालाको उचाइ समुद्रसतहदेखि २,००० मिटरसम्म रहेको छ । यहाँका चट्टान स्लेट, चुनढुङ्गा, डोलोमाइट, बलौटेढुङ्गा र अन्य पत्रेचट्टान तथा फिलाइट र क्वार्टजाइटजस्ता निम्नस्तरीय कायान्तरित चट्टानले बनेका छन् । महाभारत र चुरे शृङ्खलालाई छुट्याउने प्रमुख सीमावर्ती भ्रंश (Main Boundry Thrust) एक सक्रिय भ्रंश भएकाले त्यहाँ भूइँचालो जानसक्ने सम्भावना पनि बढी र हुन्छ ।

मध्यपहाडी क्षेत्र : मध्यपहाडी क्षेत्र महाभारत शृङ्खलाको उत्तरतिर र उच्चहिमाली क्षेत्रको बीचमा अवस्थित छ। यो क्षेत्र हिमालयको सबभन्दा पुरानो चट्टानको समूहले बनेको छ । फिलाइट, क्वार्टाजाइट, शिश्ट, डोमोलाइट, चुनढुङ्गा र स्लेटहरू यस क्षेत्रमा पाइन्छन् । यस क्षेत्रका पहाड तुलनात्मकरूपमा साना र कम भिराला हुने भएकाले खेतीपाती प्रशस्त गरिन्छ । लामो समयदेखि चट्टान सतहमा रहेकाले यस क्षेत्रमा भू-क्षय र क्षयीकरण निरन्तर भइरहन्छ ।

उच्चहिमालय

यस क्षेत्रको दक्षिणी सिमानामा अवस्थित प्रमुख केन्द्रीय भ्रंश (Main Central Thrust) ले निम्नहिमालय र उच्चहिमालयलाई छुट्याउँछ । यहाँका चुचुराको अधिकतम उचाइ ८,००० भन्दा माथि पुग्दछ। ८,८४८ मिटर उचाइ भएको विश्वको सर्वोच्च शिखर सगरमाथासमेत उच्चहिमालय क्षेत्रमै पर्दछ । यहाँका हिमालय पर्वत मध्यदेखि उच्चचाप र तापमानमा बनेका नाइस, मिग्माटाइट, सिंगमर्मर र ग्रेनाइटजस्ता कायान्तरित आग्नेय चट्टानले बनेको छन् ।

अत्यन्त भिराला पाखा र कडा चट्टानहरूले गर्दा यस क्षेत्रमा जनघनत्व त्यति धेरै छैन । काठमाडौं उपत्यका पनि यस्तै चट्टानमाथि रहेको तालको नरम कालो माटो र बालुवाका परतले बनेको छ ।

उच्चहिमालय क्षेत्रको उत्तरी भागमा हिमाच्छादित चुचुरा छन् र त्यहाँबाट निस्कने हिमनदी तथा हिमतालले यहाँका उपत्यका ढाकिएका छन् । समय-समयमा त्यस्ता हिमताल विस्फोटन हुँदा तल्लो भेगमा ठूलो बाढी ल्याउने र व्यापक क्षति पुऱ्याउने गर्दछ ।

तिब्बत-टेथिस क्षेत्र

नेपालका धेरैजसो उच्चतम चुचुरा र ती चुचुराभन्दा उत्तरतिरका क्षेत्र तिब्बत-टेथिसका पत्रेचट्टानहरूले बनेका छन् । हिमालयका उच्चशृङ्खलाले बादल र हावा दक्षिणतिरै रोकिदिने भएकाले यहाँ अत्यन्त न्यून वर्षा हुनेहुँदा यहाँका नाङ्गापाखा उब्जाउ हुँदैनन् । चारैतिरको दृष्य मरुभूमिजस्तो लाग्दछ । मात्र गहिरा नदीका उपत्यकामा केही हरियाली देख्न पाइन्छ । यहाँका नदीले ढुङ्गामाटो धेरै बगाउने भएकाले नदीको पानी पनि प्रायः धमिलो नै देख्न पाइन्छ ।

हिमालयको उत्पत्ति र यसको भू-स्वरूपको विकास

करिब ५ करोड वर्षपहिले भारतीय उपमहाद्वीपको भू-खण्ड एसियन महाद्वीपको भू-खण्डसँग ठोक्किन पुग्दा हिमालयको उत्पत्ति भएको हो । यसक्रममा भारतीय उपमहाद्वीपको उत्तरी सीमामा सर्वप्रथम कम उचाइ भएका सानातिना पहाड बन्न थाले । यसैक्रममा अहिले हिमालपारिबाट बग्दै आउने अरुण, तमोर, दूधकोसी, भोटेकोसी, मस्याङ्दी, कालीगण्डकी र कर्णालीजस्ता नदीको उत्पत्ति भयो । भारतीय उपमहाद्वीपमा पर्ने प्रतिबलका कारण क्रमैसँग उत्तरबाट दक्षिणतर्फ चन्द्राकार स्वरूपमा रहेका भ्रंशहरू बन्दै गए र कालान्तरमा उच्चहिमालयक्षेत्रका अग्ला पहाड बन्नपुगे । यसप्रकार माथिउल्लिखित हिमालयभन्दा पुराना नदीहरूले अहिले संसारकै सबैभन्दा गहिरा खोँच पनि बनाएका छन् । हिमालय प्रतिवर्ष करिब चार मिलिमिटर माथितिर सर्दैछ । भारतीय उपमहाद्वीप एसियन महाद्वीपसँग ठोक्किने क्रममा झन्डै ४,००० मिटर अग्लो तिब्बती पठार को पनि उत्पत्ति भयो । द्रूतगतिमा माथि उठ्ने र दक्षिणतर्फ सर्ने क्रममा हिमालय शृङ्खलामा संसारकै सबभन्दा अग्ला टाकुरादेखि गङ्गाको समतल मैदानसम्मका विभिन्न भू-स्वरूप (चित्र ६) को विकास भयो। यहाँ पाइने भू-स्वरूपलाई निम्नभागमा विभाजन गरी अध्ययन गर्न सकिन्छ ।

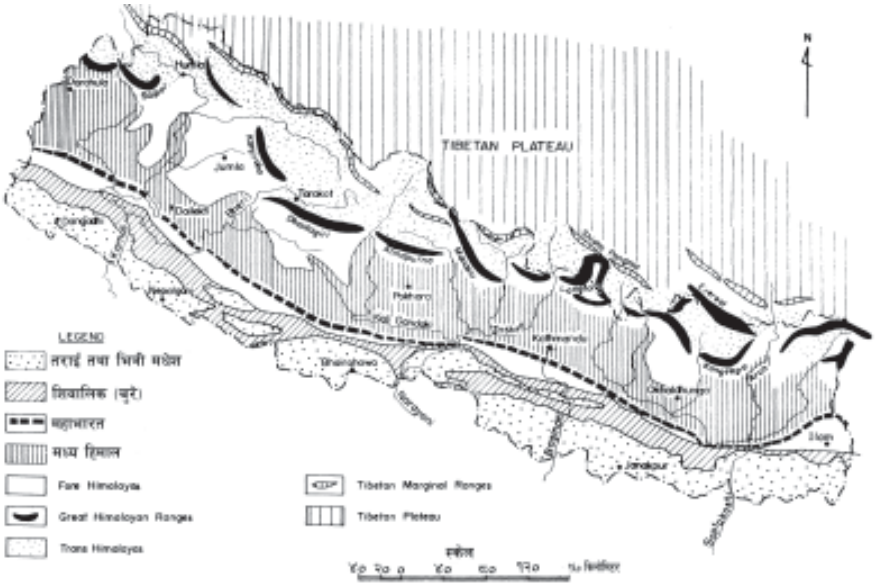
हिमाच्छादित भू-स्वरूप : उत्तरी हिमालयको हिमाच्छादितक्षेत्र करिब ५,००० मिटरभन्दा माथिको उचाइमा पर्दछ । यहाँ हिमनदी, हिमोड र हिमतालको अवस्थिति छ । यहाँ हिमनदीले बगाएका वस्तु थुपारेर बनेका उपत्यका र 'U' आकारमा काटिएका खोँच प्रशस्त भेटिन्छन् । यस क्षेत्रमा हिमताल विस्फोटन र हिमपहिरो जाने प्रकोपको बाहुल्य रहन्छ ।

उच्चपहाडी भू-स्वरूप : हिमाच्छादित क्षेत्रभन्दा मुनि पाइने भू-स्वरूप पुराना हिमोड र हिमताल विस्फोटबाट थुप्रेका ढुङ्गा-माटोले बनेको हुन्छ। प्रायः तिब्बतबाट बग्ने नदीका किनारामा यस्ता भू-स्वरूपका अवशेष पाइन्छन् । त्यसबाहेक, यहाँ अत्यन्त ठूला चट्टानी पहिरो पनि जाने गर्दछ । त्यस्तो पहिरोले कहिलेकाहीँ कालीगण्डकीजस्ता ठूला नदीलाई पनि केही दिनसम्म थुन्न सक्छ । त्यस्तो पहिरोले बनेको बाँध एकाएक फुट्दा ठूलो बाढी र छाल उर्लेर आउने मात्र होइन, त्यसले तल्लो तटीयक्षेत्रमा धनजनको व्यापक क्षति पुऱ्याउँदछ ।

मध्यपहाडी भू-स्वरूप : यो क्षेत्र तुलनात्मकरूपमा कम भिरालो र होचो भएकाले नदी र अपक्षयजन्य प्रक्रियाहरूले यहाँको भू-स्वरूपको निर्माणमा मुख्य भूमिका खेल्दछ । यहाँ नागबेली आकारका नदी, ठूला टार र चौडा फाँट पाइन्छन् ।

महाभारत पर्वतमालाको भू-स्वरूप : महाभारत पर्वत (चित्र ३) मध्यपहाडी क्षेत्रभन्दा तुलनात्मकरूपले अग्लो र ठाडो रहेको छ । यसको तल्लो भाग नदीले कटान गर्ने र यसको दक्षिणतिर रहेका प्रमुख सीमावर्ती भ्रंश तथा त्यससँगै जोडिएका सहायक भ्रंशहरूले गर्दा चट्टान फुट्नगई पहिरो जाने गर्दछ । महाभारतक्षेत्र वरिपरि मनसुनी वर्षा पनि निकै हुने भएकाले यहाँका नदी-नालामा बाढी र भू-स्खलन हुँदा धनजनको व्यापक क्षति हुन्छ ।

चुरेपहाडको भू-स्वरूप : खुकुला र कमजोर चट्टानले बनेको चुरेपहाडको धरातल अत्यन्त कमजोर छ। वनजङ्गल फँडानी, अतिचरि चरन र अतिवृष्टिले यहाँ भू-क्षय, पहिरो र नदीकटान अत्यधिक मात्रामा हुन्छ। यहाँका दक्षिणी मोहोडा परेका पहाड बढी भिराला र ठाडा छन् भने उत्तरी मोहोडा प्रायः कम भिरालो र उब्जाउशील छ ।



चित्र ६ : नेपालको भौगर्भिक विभाजनको स्वरूप (Hagen 1969)

तराईको भू-स्वरूप : समतल तराईक्षेत्रमा रहेका खोलाहरू नागबेली आकारमा बग्दछन् । त्यहाँ खोलाले थुपारेको पाँगो माटो पाइन्छ र विभिन्न तहका नदीका टारहरू (River Terraces) खोलाका दुवै किनारमा हुन्छन् । यस क्षेत्रमा ताल, पोखरी र दलदलक्षेत्र पनि बन्दछन् । यसको ठूलो भाग वर्षायाममा डुबानमा पर्नेगर्दछ । त्यस समयमा खोलाका किनारमा बन्ने ठाडा पाखाहरूमा नदीकटान धेरै हुने गर्दछ ।

नेपालमा भौगोलिक संरचनासँग सम्बन्धित प्रकोप

भौगोलिक स्वरूप आफैँमा कुनै प्रकोपको कारक हुँदैन । प्रकोप मानवजनित क्रियाकलापसँग कुनै न कुनै रूपमा सम्बन्धित हुन्छ । उदाहरणकै रूपमा लिनुपर्दा भुइँचालो आफैँले केही हानि पुऱ्याउँदैन । तर, भुइँचालो आएको क्षेत्रमा मानिसले निर्माण गरेका कमजोर संरचना भत्केर धनजनको क्षति हुन्छ । यस परिप्रेक्ष्यमा चट्टानहरूमा हुने भौगर्भिक प्रक्रियाहरू र तिनीहरूसँग सम्बन्धित प्रमुख प्रकोपका विषयमा जानकारी लिनु उपयुक्त हुन्छ ।

भुइँचालो : हिमालयमा भारतीय उपमहाद्वीप निरन्तर उत्तरतर्फ सर्नेक्रममा एसियन महाद्वीपसँग ठोक्किन पुग्दा समय-समयमा प्रभावशाली भुइँचालो (चित्र ७) जाने गर्दछ । नेपालमा अहिलेसम्म थाहा भएका प्रमुख विनासकारी भुइँचालो तालिका १ मा दिइएको छ । चित्र ८ मा नेपाल र यसका आसपासका क्षेत्रमा गएका भुइँचालोका केन्द्रबिन्दु देखाइएका छन् ।

बाढी : खासगरी, नेपालको तराई र कहिलेकाहीँ काठमाडौँ उपत्यका, हेटौँडा, चितवन र अन्य उपत्यकामा बाढीको प्रकोप बढी भएको पाइन्छ । अतिवृष्टि, अविरल वर्षा र कहिलेकाहीँ मानिसले पानीको उपयोगका लागि निर्माण गरेका संरचना भत्कँदा पनि बाढी आउँछ । नेपालका नदीनालाको बनावट भौगर्भिक कारणद्वारा नियन्त्रित छ । फलस्वरूप, पहाडी भागका साँघुरा नदी, उपत्यका र तराईमा आइपुग्दा एकाएक फराकिला हुनपुग्दछन् र बाढीको रूपमा चारैतिर फिँजिन्छन् ।

नेपालमा विसं २०५० सालको बाढी धेरैको स्मृतिमा अझै ताजै छ । यसले मध्यनेपालको तराईक्षेत्रमा ठूलो धनजन क्षति पुऱ्याएको थियो । यसबाट कुलेखानी जलविद्युत् योजना, बागमती सिँचाइ आयोजना र त्रिभुवन तथा पृथ्वी राजमार्गमा निकै क्षति पुगेको थियो । आग्राखोला, बल्खुखोला र मलेखुखोलाका पुलहरू बाढीले पूर्णरूपले क्षतिग्रस्त पारेको थियो ।

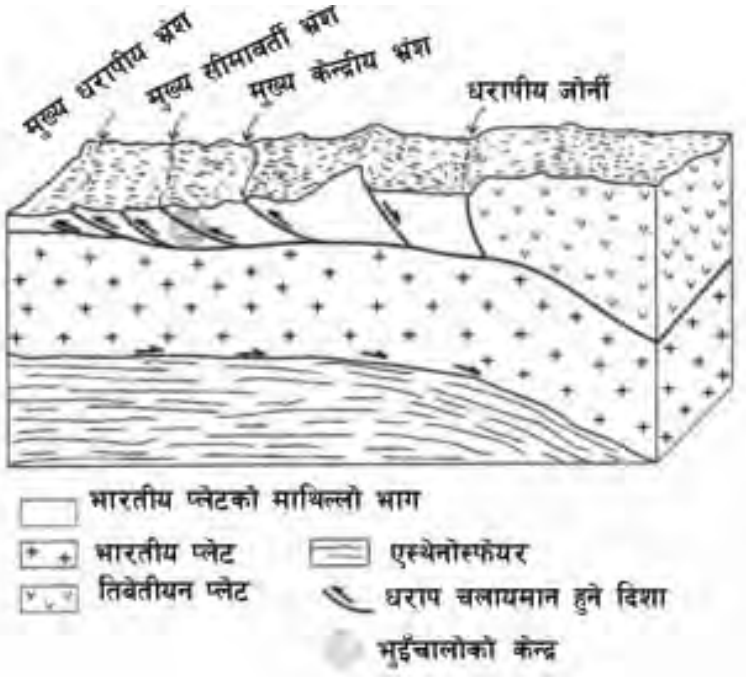
बाढीको प्रमुख कारण मनसुनी वर्षाको असमानुपातिक वितरण हो। प्रथमत: बङ्गालको खाडीबाट उठेको मनसुनी बादल पूर्वबाट पश्चिमतिर जाँदा वर्षाको मात्रा र वर्षा हुने अवधि घट्दै जान्छ । त्यसबाहेक, तराईबाट चुरे शृङ्खलामा बढ्दा यसको प्रभाव दक्षिणबाट उत्तरतिर क्रमश: घट्दै जान्छ । त्यसैगरी, चुरेपर्वतमाला पार गरी महाभारत पर्वत बढ्दा र महाभारत पर्वतबाट हिमालसम्म पुग्दा त्यहाँ भएको जम्मैजसो 'नमी वर्षा' हिउँको रूपमा (चित्र ९) तल झरिसक्छ र हिमालपारि वर्षा नै हुँदैन । त्यसैले हिमालपारिको क्षेत्र करिब-करिब वर्षाविहीन हुनपुग्दछ । त्यसैले नेपालका चुरे, महाभारत र हिमाली शृङ्खलाका दक्षिणी मोहोडामा उत्तरी मोहडामा भन्दा बढी पानी पर्दछ । फलस्वरूप, चुरे शृङ्खलामा सबभन्दा बढी खहरेखोला पाइन्छन् भने हिमालपारि खहरेखोला निकै कम छन् ।

पहिरो : पृथ्वीको गुरुत्वाकर्षणले गर्दा जमिन, चट्टान अथवा वनपाखाको केही भाग स्पष्टरूपमा तलतिर झर्ने प्रक्रियालाई पहिरो अथवा भू-स्खलन भनिन्छ । यसरी तल झर्ने वा सर्ने क्रममा उक्त पदार्थ खस्ने, भाँच्चिने, चिप्लने, फैलने अथवा बग्ने गर्दछ ।

प्राय: ठाडा र भिराला पाखामा बढी पहिरो जानेगरेको पाइए पनि कम

तालिका १ : नेपाल केन्द्रबिन्दु भई गएका ऐतिहासिक भुइँचालाहरू (Bajracharya 1994)

क्र.सं.	मिति (वि. सं.)	क्षति
१	१०१३ असार	धेरै मन्दिर र घर, राजा अभय मल्लसमेत हजारौँ उपत्यकाबासीको मृत्यु
२	१३१६	जनधनको ठूलो क्षति र त्यसको प्रभावबाट अनिकाल लागेको ।
३	१४६४, भदौ	जनधन र पशुको ठूलो क्षति र रातो मच्छिन्द्रनाथको मन्दिरको पनि क्षति ।
४	१७३७, पुस	धेरै जनधनको क्षति
५	१७३८, जेठ	जनधन र घरहरूको ठूलो क्षति ।
६	१८२४, असार	एक दिनमै २१ पटक गएको भूइँचालोबाट व्यापक जनधनको क्षति ।
७	१८६६, जेठ	ऐतिहासिक सम्पदाका रूपमा रहेका मन्दिरहरू क्षतिग्रस्त ।
८	१८८०, यमपञ्चमी	ठूलो भूइँचालो आएको भए पनि जनधनको क्षति भने धेरै नभएको ।
९	१८९०, भदौ	काठमाडौँ उपत्यकाका सहरहरू प्रभावित ।
१०	१८९१ असारदेखि भदौ	धेरै भूइँचालो गए पनि जनधनको क्षति थोरै मात्र भएको ।
११	१९७३	नेपालको सुदुरपश्चिममा धेरै ठूलो क्षति ।
१२	१९८३ माघ	भारतको पटना र बिहार प्रभावित, नेपालमा न्युन प्रभाव ।
१३	१९९०, माघ	३,८५० पुरुष र ४,६६९ महिलासहित ८,५१९ को मृत्यु, धरहरा, घन्टाघरसहित हजारौँ मन्दिर, घर नष्ट भएर धेरै ठूलो क्षति भएको ।
१४	२०२३, असार	सुदुरपश्चिममा २४ मानिसको मृत्यु र १,३०० भन्दा बढी घर भत्केर ठूलो क्षति ।
१५	२०३७, साउन	बझाङ जिल्लावरपर ठूलो क्षति । १०३ जनाको मृत्यु तथा २,५०० भन्दा बढी घर क्षतिग्रस्त ।
१६	२०४५, भदौ	उदयपुर जिल्लामा केन्द्रबिन्दु भएको भूइँचालोबाट ७२१ जनाको मृत्यु तथा ६५,००० भन्दा बढी घरहरूमा क्षति ।



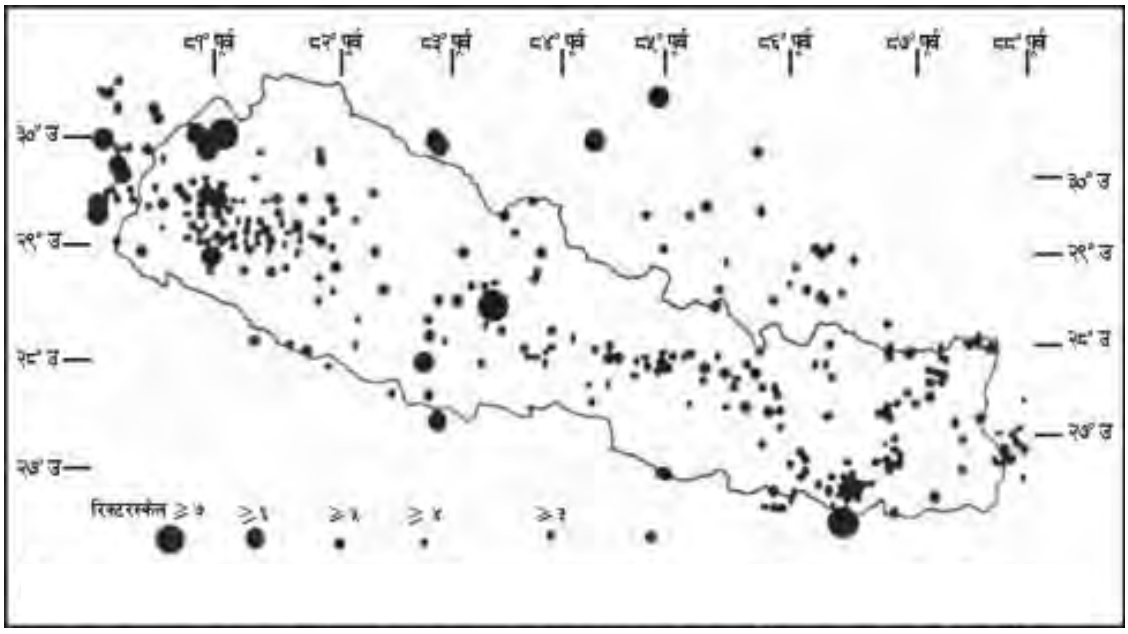
चित्र ७: भारतीय र तिबेतियन प्लेटको संरचना ।

भिरालो जमिनमा पनि पहिरो जानसक्छ ।

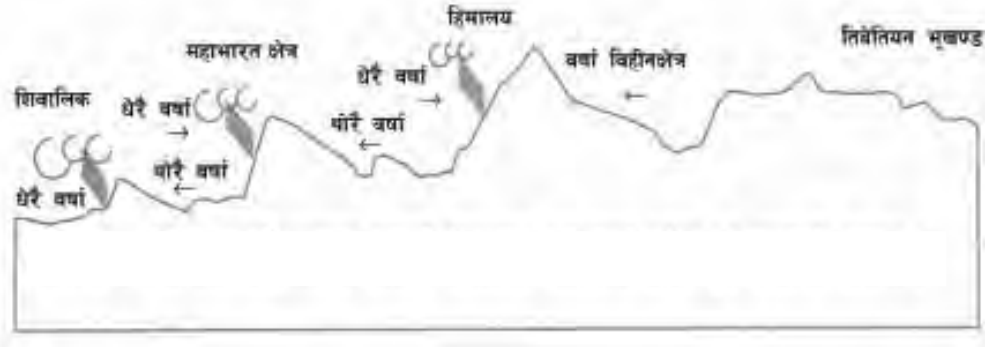
पहिरोका विभिन्न भाग : भूमिको बनोट, प्राकृतिक अवस्था र पहिरो जान सहयोग पुग्ने अन्य क्रियाकलापका आधारमा पहिरोको स्वरूप निर्धारित हुन्छ । पहिरो जाँदा यसका विभिन्न अवस्था सिर्जना भएर (चित्र १०) विभिन्न भाग देखापर्दछन् ।

धाँजा फाटेको भाग (Zone of Cracks) : पहिरो झर्न सुरु भएको ठाउँको ठीक माथितिर र कहिलेकाहीँ वरिपरि धाँजाहरू वा दरारहरू देख्न सकिन्छ । चित्र १० को माथिल्लो भागमा यस्तै धाँजा देखाइएको छ । ती धाँजाबाट वर्षायाममा पानी भित्र पसी पहिरोलाई सक्रिय बनाउँदछ ।

उद्गमस्थल (Source area) : यो पहिरोको माथिल्लो भाग हो । यहाँबाट पहिरो झर्नेक्रम सुरु हुन्छ र यहाँको खुकुलो ढुङ्गा-माटो क्रमशः



चित्र ८ : नेपाल र आसपासका क्षेत्रमा हालसम्म गएका भूइँचालोका केन्द्रबिन्दु (Bajracharya 1994)



चित्र ९ : नेपालमा दक्षिणबाट उत्तरी हिमालय पर्वततर्फ जाँदा हुने वर्षाको स्वरूप

तलतिर झर्दैजान्छ। चित्र १० को माथिल्लो भागमा पहिरोको उद्‌गमस्थल देखाइएको छ।

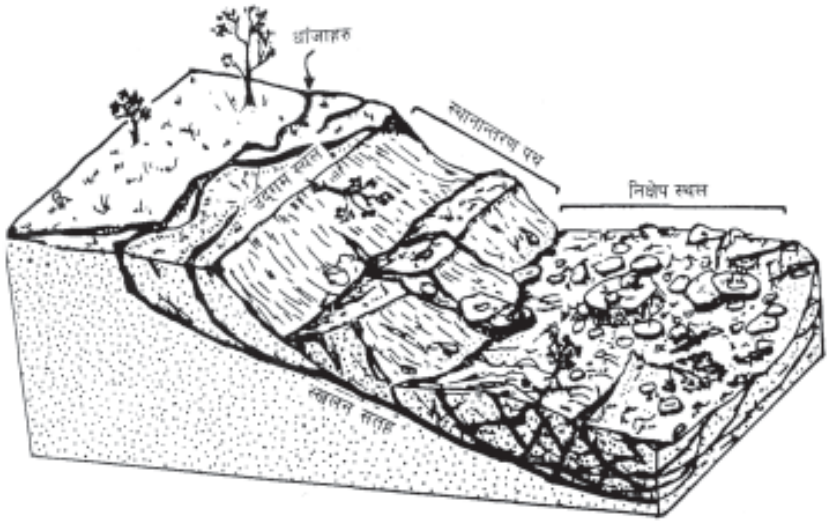
निक्षेप स्थल (Deposition Zone) : यो ठाउँमा पहिरोले ल्याएका ढुङ्गामाटो र अन्य जैविक तथा अजैविक वस्तु थुप्रिएर रहेको हुन्छ। यो भाग पनि अस्थिर नै हुनसक्दछ। चित्र १० को तल्लो भागमा निक्षेप स्थल देखाइएको छ।

पहिरोका प्रकार : पहिरोको वर्गीकरण विभिन्न देशमा फरक-फरक तरि काले गरिन्छ। यहाँ भार्न्स (Varnes 1978) द्वारा प्रस्तावित पहिरोको वर्गीकरण प्रस्तुत गरिएको छ। भार्न्सले पहिरोलाई ढुङ्गामाटोको किसिम र गतिका आधारमा वर्गीकरण गरेका छन्। तीमध्ये प्रमुख किसिम निम्न छन्।

पतन (Fall) : पतन भन्नाले एक्कासि अग्लो ठाउँमा ढुङ्गा-माटो अथवा चट्टान खस्ने प्रक्रियालाई बुझाउँछ। यसरी झर्ने पदार्थ ठाडो भीरबाट हुत्तिएर तलतिर खस्छ।

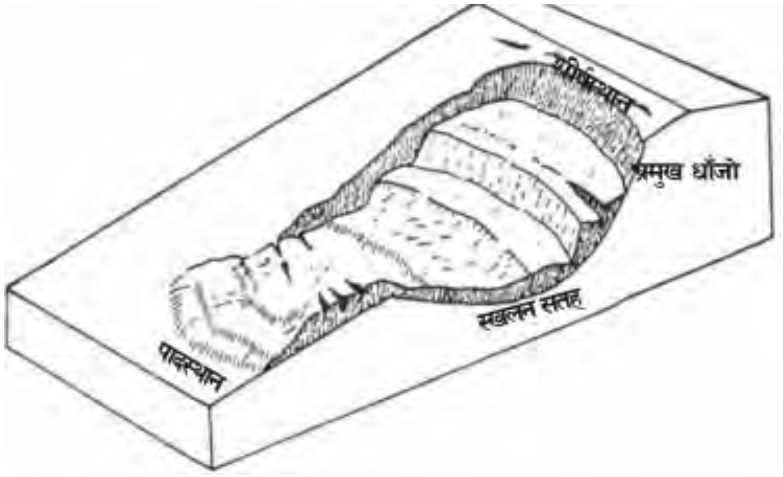
विभञ्जन (Topple) : विभञ्जन पहिरोको त्यस्तो प्रक्रिया हो, जसमा चट्टानको केही भाग तल झुक्छ, नुहिन्छ, बाहिरतिर बाँधिइन्छ, घुम्छ, अथवा भाँचिन्छ। यस्तो बाङ्गिने र घुम्ने प्रक्रिया कुनै एक अक्ष अथवा जोर्नीबाट हुन्छ। पछिगएर, उक्त चट्टानको मुख्य भागबाट अलग्गिएको टुक्रा तलतिर उछिट्टिन्छ अथवा गुड्दछ। चित्र ११ मा विभञ्जनका विभिन्न अवस्था देखाइएका छन्।

स्खलन (Slide) : विस्तृत अर्थमा भू-स्खलन भन्नाले सबैखाले पहिरोलाई बुझाउने भए पनि सङ्कुचित अर्थमा स्खलन भन्नाले ढुङ्गा, माटो अथवा चट्टानको केही भाग तलतिर चिप्लँदा स्थिर भागसँग एक स्पष्ट चिप्लने सतह बनाउने प्रक्रियालाई जनाउँछ। स्खलनका प्रमुख दुईप्रकार छन् :



चित्र १० : पहिराका बिभिन्न भाग

चित्र ११: विभञ्जनका विभिन्न अवस्था



चित्र १२: घूर्णस्खलनका विभिन्न भागहरु (Varnes 1978)

स्थानान्तरित स्खलन (Translational Slide) : स्थानान्तरित स्खलनमा जमिन समतल छड्केसतहमा तलतिर र बाहिरतिर चिप्लने गर्दछ । यस्तो पहिरोमा घुमाउरो गति हुँदैन । यदि पहिरो जाने स्थान अनुकूल भयो भने यस्तो पहिरो निकै लामो पनि हुनसक्दछ ।

फलकाकार स्खलन (Wedge Failure) : फलाकार अथवा फेसो आकारको पहिरो नेपालमा पाइने चट्टानमा प्रशस्त गएको भेटिन्छ । यस्तो पहिरो चट्टानमा भएका जोर्नी (Joint) हरूबाट नियन्त्रित हुन्छ ।

घूर्ण (वक्राकार) स्खलन (Rotational slide) : यस्तो पहिरोको स्खलन सतह चम्चाजस्तो घुमेको हुन्छ । यसमा स्खलन प्रक्रिया (चित्र १०) कुनै एउटा धुरीवरिपरि हुन्छ । देउखुरी उपत्यकाको दक्षिणमा पर्ने उच्चशिवालिक चट्टानमा गएको पूर्णस्खलन (फोटो १) ले खोलालाई थुनेर कहिले व्यापक क्षति पुऱ्यायो ।

हिमपहिरो र हिमताल विस्फोट (Snow Avalanche and Glacier Lake Outburst Flood)

उच्च हिमालीक्षेत्रको तल्लो भागमा हिमपहिरो र हिमताल विस्फोट हुने खतरा बढी रहन्छ । हिउँको बाक्लो परत ठाडो सतहमा जम्नगयो भने गर्मीयाममा तल्लो सतहको हिउँ पग्लन गई हिमपहिरो जानसक्दछ । यस्तो हिमपहिरो अत्यधिक गतिमा तलतिर झर्ने भएकाले जनधनको व्यापक क्षति हुनसक्छ । जमेको बरफले हिमनदी पग्लने ठाउँका हिमोड छेकेर बन्ने पोखरीलाई हिमताल भनिन्छ । यस्तो पोखरीमा धेरै पानी जम्मा भएमा हिमताल विस्फोटको खतरा बढ्दछ । दोलखा जिल्लाको च्छो-रोल्पा हिमताल विस्फोट हुने खतरा निकै बढेपछि त्यहाँको तालबाट साइफनिङ गरी (फोटो २) पानी निकास गर्ने छुट्टै व्यवस्था मिलाइएको छ ।

सम्मिश्रण बहन (Debris Flow) : सम्मिश्रण बहन यस्तो खालको प्रक्रिया हो, जसमा ढुङ्गा-माटो, चट्टानका टुक्राटुक्री, प्राङ्गारिक तत्वहरू, रूखपात पानी र हावाको सम्पर्कमा आउँदा लेदो बन्दछ । त्यस्तो सम्मिश्रण तीव्र गतिमा माथिबाट तलतिर बग्दछ । सम्मिश्रण बहने ठाउँमा प्रायः ठाडा खोल्सा हुने गर्दछन् । यस्ता सम्मिश्रण बहनले बनाएका पङ्खाकार थुप्रा (Fans) खोल्साको तल्लो भागमा भेटिन्छन् । फोटो ३ र चित्र १३ मा २०५० सालको बाढी र सम्मिश्रण बहनले पुऱ्याएको क्षति स्पष्ट देखिन्छ ।

नेपालमा भौगर्भिक पक्षबाट हुने प्रकोपका कारण

नियमित चल्ने प्रकृतिको संरचनात्मक क्रिया-प्रतिक्रिया तथा मानवजन्य क्रियाकलापका कारण पृथ्वीको स्थलस्वरूपमा, चट्टान वा ढुङ्गामाटोमा आउने परिवर्तन र जमिनभित्रको प्रवृत्तिमा समेत बद्लाव आउनाले त्यहाँ प्रकोपको अवस्था सिर्जना हुन्छ । कुनै स्थानको भौगर्भिक बनावट, हावापानी र मानवजन्य क्रियाकलापको समष्टिगत असर नै प्रकोपको रूपमा देखापर्दछ । त्यस्ता कारक तत्वलाई निम्न किसिममा विभाजन गर्न सकिन्छ ।

दीर्घकालीन कारण :

कुनै स्थानको चट्टानको आन्तरिक बनावट, त्यसमा भएका सम्भेद तथा ढुङ्गा र माटोको आन्तरिक संरचनाजस्ता प्राथमिकस्तरका कारकतत्वहरू दीर्घकालसम्म अपरिवर्तनीय हुन्छन् । यस्तो कारणलाई हामीले बदल्न नसक्ने भएकाले त्यहाँ आउनसक्ने प्रकोपको न्यूनीकरण गर्न अन्य उपाय अवलम्बन गर्नुपर्दछ ।

अल्पकालीन कारण :

अतिवृष्टि, हिउँ पग्लने प्रक्रियामा वृद्धि, भूमिगत जलको सतहमा घटबढ हुनेक्रम, खोलाले किनारा कटानजस्ता प्रक्रिया प्रकोप निम्त्याउने अल्पकालीन कारक तत्वमा पर्दछन् । यी कारक तत्वलाई पहिले नै अध्ययन गरी पहिचान गर्न सकिने भएकाले तिनीहरूले पार्नसक्ने प्रभाव समयमै न्यूनीकरण गरेमा भविष्यमा हुनसक्ने प्रकोप टार्न सकिन्छ ।

सुषुप्त कारण :

भुइँचालो र ज्वालामुखीजस्ता प्रकोपजन्य कारण अत्यन्त खतरनाक हुन्छन् । यसमध्ये नेपालमा ज्वालामुखीको खतरा नै नभएकाले भुइँचालो एकमात्र सुषुप्त कारण हो । प्रायः भुइँचालोको पूर्वानुमान गर्न निकै कठिनाइ हुने भएकाले निर्माण भइसकेका र पछि बन्ने भौतिक संरचना सकेसम्म भूकम्पप्रतिरोधात्मक क्षमता भएका हुनुपर्दछ । यदि पहिले बनिसकेका संरचना भूकम्पप्रतिरोधात्मक छैनन् भने मर्मतसम्भार गरी तोकिएको मापदण्डअनुकूल सुधार गर्नुपर्दछ ।

मानवजन्य कारण :

पृथ्वीको भू-सतहमा प्राणी र प्रकृतिबीच अन्तर्क्रिया भइरहन्छ । त्यसमा पनि मानवीय गतिविधि अत्यधिक हुने हुँदा मानिस र प्रकृतिबीचको अन्तर्क्रिया तीव्ररूपमा चलिरहन्छ । यसक्रममा, कहिलेकाहीँ मान्छेका क्रियाकलापले प्रकोप निम्त्याउने र प्राकृतिकरूपमा हुने प्रकोपलाई भयावह बनाउन सहयोग गरिरहेको हुन्छ (फोटो ४)। मानिसद्वारा प्रकोप बढ्न र विस्तार हुन सहयोग पुग्ने केही प्रमुख कारणलाई निम्नानुसार लिन सकिन्छ ।

कटान कार्य : सडक, पुल, बाँध, कुलो आदि बनाउँदा पाखाको फेद काट्ने, खन्ने वा सम्याउने कार्य गर्दा भू-सतहमा विचलन आई पहिरो जाने सम्भावना बढ्दछ । कुलो खनेर एक ठाउँको पानी अर्को ठाउँमा पुऱ्याइयो भने पानी बग्ने बाटोमा परिवर्तन आउँदछ । यसरी नयाँ बाटोमा पानी बग्न थाल्दा कुनै ठाउँमा जमिन कटान गर्ने र कुनै ठाउँमा माटो थुपार्ने प्रक्रियामा वृद्धि हुन्छ । यस प्रक्रियामा त्यहाँको भूमिगत जलप्रवाहमा पनि असर पुग्दछ ।

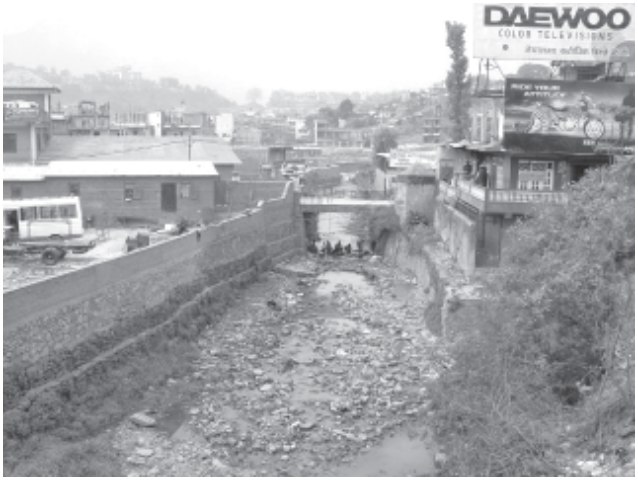
अतिरिक्त भार : सिमान्त सन्तुलनमा रहेका पाखामा घर बनाउँदा, खाल्टो खन्दा वा बाटो बनाउँदा अतिरिक्त भार थपिनगई सो जमिन कमजोर र अस्थिर बन्दछ । यस्तो अतिरिक्त भारले पहिरो जाने, भू-क्षय हुने र त्यहाँका संरचना भत्काउने खतरा बढ्छ ।

वनफँडानी : वनजङ्गल प्राकृतिकरूपमा वातावरण, जैविक विविधता र भूमिको संरक्षणको सर्वाधिक महत्वपूर्ण स्रोत हो । प्रकोप उत्पन्न गर्न वनविनासले निकै ठूलो भूमिका निर्वाह गर्दछ । वनजङ्गलको जथाभावी फँडानी, गाईबस्तुको चरिचरन, खोरियाफँडानी र अवैज्ञानिक खेतीप्रणालीले जमिनलाई अड्याइराख्ने बोटबिरुवा सखाप हुन्छन् र त्यस्ता ठाउँहरूमा भू-क्षय, सम्मिश्रण बहन र पहिरो जाने सम्भावना अत्यधिक हुन्छ ।

फोटो १ : देउखुरी उपत्यकास्थित कक्राहा खोलामा देखिएको घूर्णस्खलन

फोटो २ : च्छोरोल्पा हिमतालको पानी निकास नहर

फोटो ३ : फेदीगाउँमा २०५० सालको संमिश्रणबहनले पुयाएको क्षतिको दृष्य



फोटो ४ : बल्खु खोलाको बगर मिचेर बनाइएका घरहरुको अवस्था अत्यन्त जोखिमपूर्ण छ ।

जमिनको भिरालोपन बढाउने कार्य : भू-स्खलन हुनुमा मानवजन्य वा प्राकृतिक कारणले जमिनको भिरालोपन बढ्नु पनि हो । त्यस्तो अवस्थामा भूमिगत जलसतहको गहिराइमा परिवर्तन आउनसक्छ । फलस्वरूप, पहिरो जाने, संरचनाको जगमा दबाब परेर भासिने, टुटफुट हुने वा विग्रने सम्भावना वृद्धि हुन्छ ।

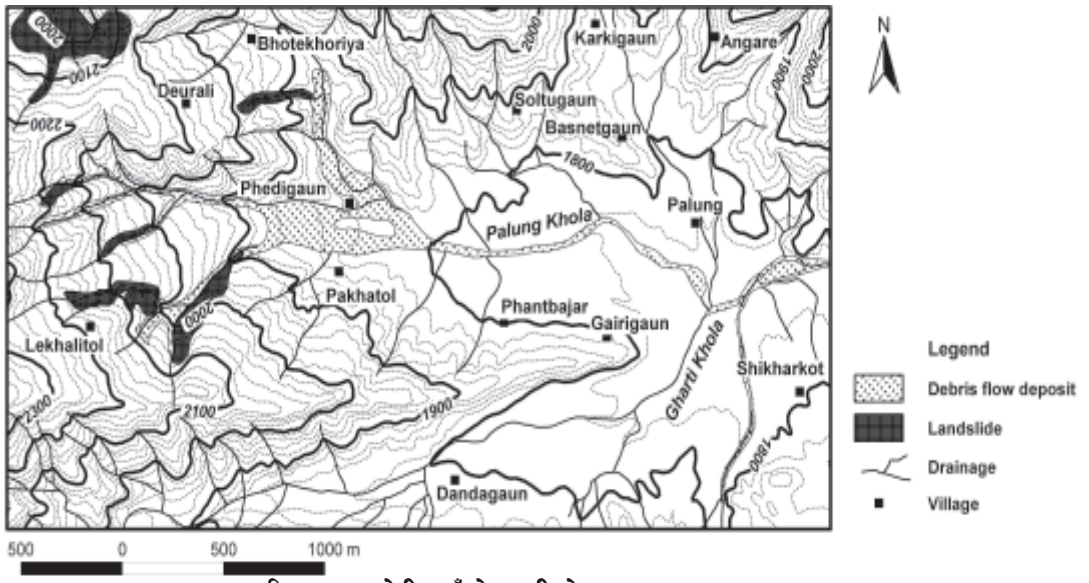
प्राकृतिक कारण :

प्रकोप निम्त्याउने प्राकृतिक कारण पनि छन् । पृथ्वीको बाह्य तथा आन्तरिक भागमा हुने परिवर्तनले प्रकोप ल्याउने अवस्था सिर्जना गर्न सक्दछन् । तीमध्ये, केही प्रमुख कारकतत्व निम्न छन् :

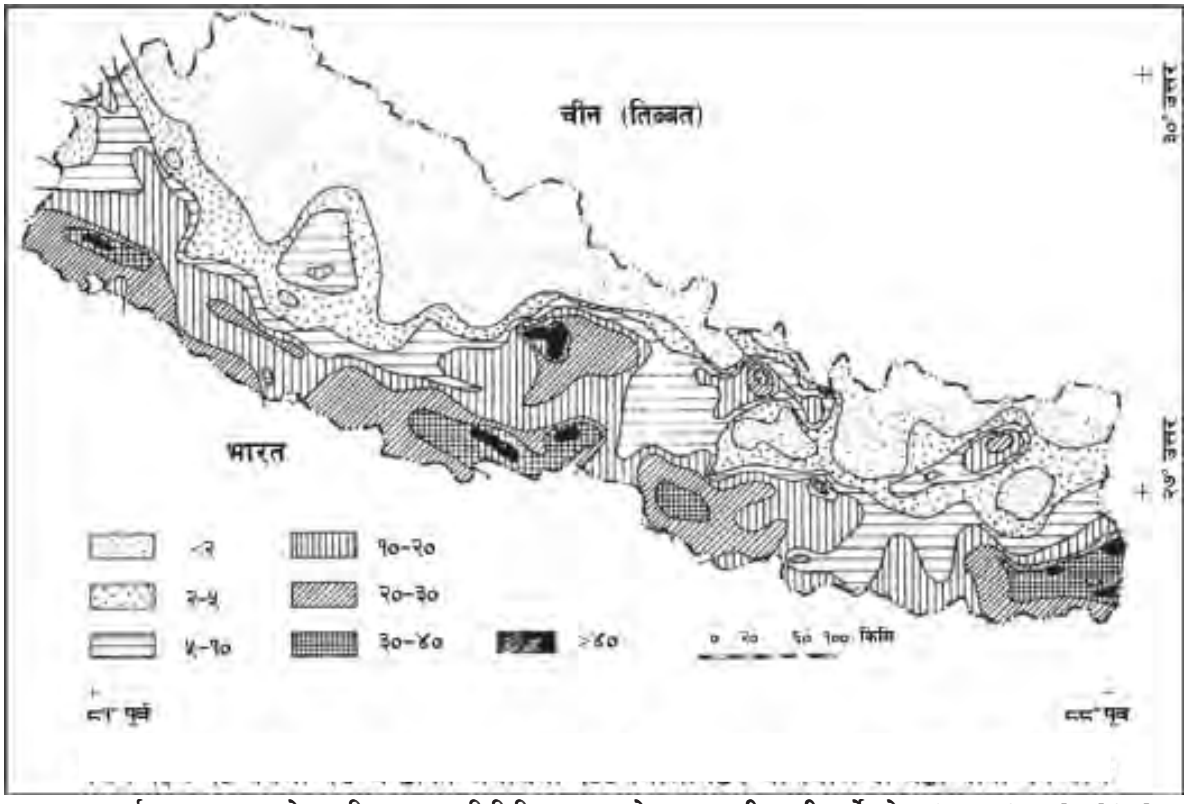
हावापानी : कुनै पनि ठाउँको हावापानीमा हुने दीर्घकालीन परिवर्तनले प्रकोपको अवस्था ल्याउनसक्छ । पर्यावरणमा आएको असन्तुलनले भू-क्षय, बाढी, पहिरो र हिमपहिरो तथा हिमताल विस्फोट निम्त्याउनसक्छ । अतिवृष्टि र बाढीले गर्दा भीरपाखामा सतही र भूमिगत जलको चाप बढ्नगई पहिरो जाने, जमिन डुब्ने, कटान हुने र सम्मिश्रण बहन हुने सम्भावना हुन्छ । त्यस्तै, हावापानीमा आएको परिवर्तनले वर्षाको प्रक्रिया कम हुँदै गएमा खडेरी पर्ने, अनिकाल पर्ने र कालान्तरमा मरुभूमीकरण हुने प्रक्रियासमेत सुरु हुन्छ ।

क्षयीकरण (Erosion) : वर्षाको पानीले जमिनबाट ढुङ्गा-माटो बगाउँदै लग्दा खोल्सा र चिरा बन्दै जमिनको सतहमा भू-क्षय हुने प्रक्रियाले निरन्तरता पाइरहेको खण्डमा कालान्तरमा जर्जर अथवा बन्जर जमिन बन्ने, पहिरो जाने र सम्मिश्रण वहन हुने सम्भावना हुन्छ । त्यसैगरी, खोलानाला, नदी तथा तालहरूका किनारको कटान हुनेक्रम बढेमा पनि भू-क्षय हुने र पहिरो जाने खतरा उत्पन्न हुन्छ ।

अपक्षय (Weathering) : पृथ्वीको सतहमा रहेका चट्टान वायु, पानी, तापमान र रासायनिक प्रतिक्रियाहरूका कारणले गर्दा कमजोर हुन पुग्नु, फुट्नु, टुट्नु र अन्ततः माटोमा बदलिन पुग्ने प्रक्रियालाई अपक्षय भनिन्छ । अपक्षयले गर्दा पहिले स्थिर रहेका चट्टान पनि कालान्तरमा असन्तुलित हुनपुग्दछन् । चट्टान खिइनाले कहिलेकाहीं कम खिइएको भाग बढी खिइएको



चित्र १३: फेदीगाउँको बाढीको खतरा नक्साङ्कन



चित्र १४ : १० वर्षमा २४ घन्टाको अवधिमा १०० मिलिमिटर वा त्यो भन्दा बढी पानी पर्ने क्षेत्र (Upreti and Dhital 1996)

भागमाथि झुन्डिनपुग्दछ र पछिगएर त्यो पनि तल खसेर पहिरोको रूप लिन्छ ।

भुइँचालो : भनिन्छ, भुइँचालो आफैँले कसैको ज्यान लिँदैन, बरु मानवनिर्मित संरचना भत्कँदा त्यसले थिचिएर, पुरिएर जनधनको व्यापक क्षति हुन्छ । तर, भुइँचालोले गर्दा विभिन्न ठाउँमा पहिरो जाने, त्यस्ता पहिरोले खोला थुनिएर ठूलो बाढी आउने, हिमताल विस्फोट हुने, हिमपहिरो खस्ने र मानवनिर्मित बाँध भत्केर तल्लो तटीयक्षेत्रमा बाढी आउनेजस्ता विभिन्न प्रकोप उत्पन्न हुनसक्छ ।

पानीको उपस्थिति : नेपालको परिप्रेक्ष्यमा पानी नै अत्यधिक प्रकोपको कारण बन्दै आएको छ । अत्यधिक वर्षा र बाढीले तराईक्षेत्र जलमग्न हुनेगरेको छ भने पहाडीक्षेत्रमा नदीकटान, सम्मिश्रण बहन र विभिन्न किसिमका पहिरा जानेक्रम बढ्दै गएको छ ।

एकतर्फ पानीले जमिनको सतह खियाएर भू-क्षय उत्पन्न गराउँछ भने अर्कोतर्फ माथिल्लो तहमा रहेको माटोलाई लेदोको रूपमा बदलिदिन्छ। फलस्वरूप, जमिनको एक परतले बहाबको रूप लिन्छ र आफूसँगै त्यहाँका ढुङ्गा-माटो बग्दै जाँदा चट्टानको अभेद्य सतह फेलापार्नासाथ, त्यहाँबाट तलतिर जान नसक्ने भएकाले आफू निस्कनका लागि कमजोर स्थान वा दरार खोज्न थाल्छ। माथिबाट पानीको चाप बढ्दै जाँदा उक्त भूमिगत जलले आफू बाहिरबाट निस्कने सतहलाई सीमा बनाएर त्योभन्दा माथिको भागलाई असन्तुलित र अस्थिर बनाइदिन्छ। यसबाट सतहको पानी र भूमिगतजल दुवै नै प्रकोपको कारकतत्व बन्दछ।

प्रकोप न्यूनीकरण तथा रोकथामका उपाय

प्रकोप न्यूनीकरण तथा रोकथाम गर्नुभन्दा पहिले उक्त क्षेत्रको विस्तृत भौगर्भिक र इन्जिनियरिङ अध्ययन हुनु आवश्यक छ। त्यस्ता अध्ययनको आधारमा त्यहाँको प्रकोपको नक्सा, जोखिमको नक्सा र त्यहाँका संरचनाको प्रकोपवहन क्षमताको नक्सा बनाउनुपर्दछ। यस्ता विभिन्न नक्साको अध्ययन तथा विश्लेषणको आधारमा प्रकोप न्यूनीकरण तथा रोकथामको कार्य गरिन्छ। यसका केही उदाहरण तल दिइएका छन्।

भूकम्पीय जोखिम नक्सा (Earthquake Hazard Map) : नेपालमा कही भूकम्पीय नक्सा बनाइएका छन्। ती नक्साअनुसार नेपालको पूर्वी तराई, पोखरावरपरको मध्यपहाडी भाग तथा दार्चुलावरपरको पहाडीक्षेत्र भूकम्पीय दृष्टिले धेरै जोखिमयुक्त रहेको छ। तर, यस्ता नक्सा निश्चित अवधारणामा आधारित भएर बनाइने भएकाले अरू अवधारणालाई भूकम्पीय जोखिमको कारण मानी नक्सा बनाउँदा यसको आकार बिल्कुलै फरक हुनसक्छ।

जलीय प्रकोपको सम्भाव्यता (Hydrological Hazard): नेपालमा भौगोलिक विविधताजस्तै मनसुनी वर्षाको स्वरूपमा पनि विविधता रहेको छ। कुनै क्षेत्रमा धेरै वर्षा भएर बाढीपहिरोको प्रकोप हुन्छ भने कतिपय स्थानमा वर्षा नभएर सुख्खा खडेरीले महामारीलगायत प्रकोप निम्त्याउने गरेको छ। चित्र १४ मा नेपालमा १० वर्षमा २४ घन्टाभित्र १०० मिलिमिटर वा त्योभन्दा बढी पानी पर्ने क्षेत्र समोच्चरेखाहरूद्वारा घेरिएका छन्। यस नक्सामा सबभन्दा बढी पोखरावरपर, पूर्वी तराईको इलाम क्षेत्र, मध्यनेपालका चितवन तथा मकवानपुर क्षेत्र र सुदूरपश्चिमका धनगढी र महेनद्रनगर पर्दछन्।

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FELICITATIONS

NEPAL GEOLOGICAL SOCIETY
नेपाल भौगर्भिक समाज

To all to whom these presents shall come, greeting:
In recognition of the contribution towards
Geoscientific research and development of the Himalaya
Nepal Geological Society
has conferred upon

Prof. Dr. Augusto Gansser (-Biaggi)

Honorary Membership of the Nepal Geological Society in the year 2005 with
all of its privileges and obligations given on this twenty-eighth day of September 2005.

जयन्तु ते सुकृतिनो रससिद्धा सुधीश्वराः
हिमालयको भूवैज्ञानिक अनुसन्धान तथा विकासमा विशिष्ट योगदान पु-याउनु भएका

प्राध्यापक डा. श्री अगष्टो ग्यान्सर (-बियागी) लाई

नेपाल भौगर्भिक समाजले २०६२ सालमा यस समाजको सम्मानित सदस्यता प्रदान गरेको छ।

(Dr. Ramesh Man Tuladhar)
President
अध्यक्ष

मिति २०६२ आश्विन १२ रोज ४ शुभम्।

Professor Dr Augusto Gansser-Biaggi

BIOGRAPHY OF HONORARY MEMBER PROFESSOR DR. AUGUSTO GANSSER-BIAGGI

Date of Birth: 28 October 1910, Milan
Nationality: Swiss
Permanent Address: Massagno (Lugano), Switzerland

Academic Performance

In 1936, he obtained his geological degree at Zurich University and he took part in the first Swiss geological expedition to the Himalaya and Southern Tibet, including a geological excursion, disguised as a pilgrim, around the sacred mountain Kailas. In 1958 Dr Gansser obtained a Professorship, and he was appointed Head of the Geological section of the Federal Institute of Technology at the Zurich University.

Research

He has been involved in geological researches since 1934. He has carried out researches in the Himalayas, the Andes, the Canadian Arctic, the Norhern Ural, Patagonia, Antarctica, the Middle East, Afghanistan, and in Roraima. He did extensive researches in the various regions of the Himalayas, namely Northern Pakistan, Ladakh, Nepal, Southern Tibet, and Bhutan. His work in the Himalayas is highly appreciated and he is considered to be one of the

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Pakistan)
oyal Geological

ciences (USA)
Lincei (Rome)

Dr A. Gansser- recieving the tocan of Honorary Membership through A. Sidler

A letter from Professor Dr Augusto Gansser-Biaggi

AUGUSTO GANSSER-BIAGGI
VIA ROVELLO 23
CH-6900 MASSAGNO (LUGANO)
TEL. 091 / 56 42 83
966.

22.9.05

To the Nepal Geological Society

Many thanks for the Honorary Membership.
I only regret that with my 94 years travelling is more difficult than it was before and that I am not able to come personally to Nepal.
However I am looking forward to reciève the honorship certificate in due time and remaine
with my best wishes
Augusto Gansser

1983

NEPAL GEOLOGICAL SOCIETY
नेपाल भौगर्भिक समाज

To all to whom these presents shall come, greeting:
In recognition of the contribution towards
Geoscientific research and development of the Himalaya
Nepal Geological Society
has conferred upon

Mr. Bishwa Man Pradhan

Honorary Membership of the Nepal Geological Society in the year 2005 with all of its privileges and obligations given on this twenty-eighth day of September 2005.

जयन्तु ते सुकृतिनो रससिद्धा सुधीश्वराः
हिमालयको भूवैज्ञानिक अनुसन्धान तथा विकासमा विशिष्ट योगदान पु-याउनु भएका

श्री विश्व मान प्रधानलाई

नेपाल भौगर्भिक समाजले २०६२ सालमा यस समाजको सम्मानित सदस्यता प्रदान गरेको छ ।

(Dr. Ramesh Man Tuladhar)
President
अध्यक्ष

मिति २०६२ आश्विन १२ रोज ४ शुभम् ।

BIO-DATA OF HONORARY MEMBER MR. BISHWAMAN PRADHAN

Date of Birth: December 5, 1931

Nationality: Nepali

Permanent Address: 76 Devishree Marg, Kumari Marg 3, Tripureshwore, Kathmandu-11, Nepal

Sex: Male

Marital Status: Married

No. of children: Four (three sons and one daughter)

Proficiency in Language:
English (excellent), Nepali (excellent), Newari (excellent), Hindi (V. Good)

Telephone: 00977-1-4241749; Mobile: 9841-349679

E-mail Address: bishwa_prad@yahoo.com

Education:

S. L. C.	1948	S. L. C. Board of Examination, Nepal
I. Sc	1950	Patna University, India
B. Sc.	1953	Patna University, India
M. S. (Geology)	1960	University of New Mexico, U. S. A.

Training:

Duration	Place	Sponsored by	Topic
June/July, 1958 (3 weeks)	New Mexico	USOM/USA	On base metal and uranium deposits
June/July, 1959 (3 weeks)	New Mexico	USOM/USA	On sedimentary structures and oil exploration
September, 1965 (3 weeks)	Ceylon	UNESCO	On land use

Job Description:

1953-1960	Technician, Nepal Bureau of Mines/HMG, Kathmandu
1960-1967	Geologist, Nepal Bureau of Mines/HMG, Kathmandu
1967-1982	Senior Geologist and Head, Department of Geology, Tri-Chandra Campus, Tribhuvan University. Kathmandu
1982-1990	Lecturer, Central Department of Geology/ Tribhuvan University, Kathmandu
1990-1991	Head, Central Department of Geology/ Tribhuvan University, Kathmandu
1991-1994	Associate Professor, Central Department of Geology/ Tribhuvan University, Kathmandu
December, 1994	Retirement

Other Services:

1973-1990	Member-Secretary, Nepal National Committee, International Geological Correlation Programme (IGCP), UNESCO
February, 1976	Organiser for Meeting on Seismicity and Seismotectonics of South East and Central Asia Sponsored by UNESCO held at Kathmandu, Nepal
March, 1978	Member of Organising Committee for International Geodynamics Conference on Alpine- Himalayan Region Sponsored by IUGS and Nepal held at Kathmandu, Nepal
1978-1982	Consultancy services to United Designers and Associates, Kathmandu
October, 1989	Organiser for "Regional Course on Geotechnical Earthquake Engineering and Earthquake Hazard Mitigation" Sponsored by UNESCO and HMG/ Nepal held at Kathmandu, Nepal
1992	life- Member, Nepal Geological Society, Kathmandu, Nepal

Symposiums, Conferences, Seminars and Meeting

September, 1974	Meeting on Seismicity and Seismotectonics of south and Central Asia sponsored by UNESCO held at Teheran, Iran
February, 1976	Meeting on Seismicity and Seismotectonics of South and Central Asia sponsored by UNESCO held at Kathmandu, Nepal
March, 1976	Meeting on IGCP Projects sponsored by UNESCO held at Calcutta, India
September, 1976	Conference on Research and development in Nepal sponsored by Tribhuvan University, Kathmandu, Nepal

March. 1977	Conference on Scientific Development in Nepal Sponsored by Royal Nepal Academy, Kathmandu, Nepal held at Kathmandu, Nepal
March, 1978	International Geodynamics Conference on Alpine-Himalayan Region sponsored by IUGS and HMG/Nepal held at Kathmandu, Nepal
November, 1980	Meeting on Seismicity and Seismotectonics on Zagros-Himalayas-Hindukush Region sponsored by UNESCO held at Istanbul, Turkey
October, 1982	Symposium on Crustal Movement in Himalayan Region, Kathmandu
September, 1986	Symposium on Oil Exploration in Nepal, Kathmandu
October, 1988	Symposium on Crustal Movement in Himalayan Region, Kathmandu
October, 1989	Seminar on Geology of Nepal Himalaya, Nepal Geological Society, Kathmandu

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Pradhan, B. M.; Kumar, R.; Shah, A. N. and Bingham, D. (1978): Geologic Setting and Tectonics of Nepal- a review. Proc., International. Geodynamics conf., Alpine- Himalayan Region, Kathmandu, 9 p

Pradhan, B. M. (1980): Report on Seismological Network for Nepal. Seismicity and Seismotectonics of Zagros-Himalayas-Hindukush Region, UNESCO Meeting, Istanbul, Turkey, 6p

Pradhan, B. M. (1989): Bibliography on Geology of Nepal Himalaya, 389p

Pradhan, B. M. (1999): Abstracts on Geology of Nepal Himalaya, 371p

Pradhan, B. M (2005): On Gems (under Preparation)

Unpublished Report:

Pradhan, B. M. and Singh, Y. L (1956): Preliminary report on investigations of reported nickel and copper ores and other mineral occurrences in Est No. 1, Nepal. Unpubl. Report, Nepal Bureau of Mines, Kathmandu

Pradhan, B. M. (1956): Preliminary report on investigation of reported coal and other mineral occurrences in Western Nepal (Tosh), Nepal. Unpubl., Nepal Bureau of Mines, Kathmandu, 8p

Pradhan, B. M. (1960): Geology of Virden Formation, Tuscon, Arizona. Unpubl., M. S. Thesis, University New Mexico, USA, 56p

Pradhan, B. M. (1961): A brief report of iron ore deposit of Labdi Khola Region, Bandipur District, West No. 3, Nepal Unpubl., Nepal Bureau of Mines, Kathmandu 5p.

Pradhan, B. M. (1961): A reconnaissance report on economic mineral resources of Kailali, Silgarhi- Doti, Bajhang and Baitadi areas, Western Nepal. Unpubl., Nepal Bureau of Mines, Kathmandu, 42p

Pradhan, B. M. (1963): Report on an investigation of power House, Reservoir, Canalways and Damsite of Morang Hydroelectric supply Co. Ltd., Unpubl., Morang Hydroelectric Supply Co. Ltd., Biratnagar, 5p

Pradhan, B. M. (1965): Summary of field work at Wapsakhani and Jantrakhani, Unpubl., Nepal Bureau of Mines, Kathmandu, 2p.

Additional Data:

- In 1956, exploration works was carried out for the development of nickel and copper ores in East No. 1 and Proposed for extensive field in the area.
- 1961–1963, Two years training course was organised and taught for the S. L. C. Passed candidates in the field of Geology, Mining, Surveying and field work to immediate development of man-power at Nepal Bureau of Mines/ HMG. After Examination of the trainees, 14 passed out of 32 and they were given jobs in the Bureau.
- The Major field works at the Bureau are:-

- Dhangarhi-Silgarhi-Doti-Bajhang-Baitadi-Darchula reconnaissance (1961)
- Reconnaissance work of iron ores at Labdi Khola area, Bandipur (1961)
- Investigation of Power House, Canalways, and Dam site of Morang Hydroelectric Supply Co. Ltd. (1963)
- Field work for the exploration of copper ores at Wapsakhani and Janterkhani (1965-1966)

1960-1967, Design and placement of laboratory requirements- furniture, water supply and drainage for Chemical Lab, Photographic Lab., Petrological Lab, and design and placement of furniture for Museum, Library and Auditorium including projection system and sound system

In 1967, Department of Geology was established for undergraduate level (B.Sc.) at Tri-chandra Campus, Tribhuvan University, Kathmandu

In 1976, There day Geological Exhibition was organised at Tri-Chandra Campus, Kathmandu.

In 1977, Further exploration work was suggested for the development of some semi-precious stones specially garnet, tourmaline and aquamarine at Sankhuwa Sabha area, eastern Nepal at the Proceedings of Royal Nepal Academy, Kathmandu.

In 1978, Graduate level (M. Sc.) Courses in Geology was established at the premises of Tri-chandra Campus, Tribhuvan University, Kathmandu

In 1980, Establishment of Seismological Stations at five Development Regions (one at each Head Quarter) in Nepal was proposed to UNESCO in the UNESCO Meeting held at Istanbul, Turkey.

The other special contributions are the publications of:

1. Bibliography on Geology of Nepal Himalaya, 389 p.
2. Abstracts on Geology of Nepal Himalaya, 371p.

Honours:

Mangsir 20, 2057: Recipient of "HONOUR OF RECOGNITION" from Science and Technology (Geology), RONAST, Khumaltar, Lalitpur.

Bhadra 12, 2060: Recipient of "FELICITATION LETTER" from Nepal Geological Students' Society, Central Department of Geology, Tribhuvan University, Kirtipur.

Aswin 12, 2062 (September 28, 2005): Recipient of HONORARY MEMBERSHIP from Nepal Geological Society, Kathmandu, Nepal

CONGRATULATIONS

Prof. Dr B. N. Upreti

The Nepal Geological Society extends its hearty congratulations to Professor Dr Bishal Nath Upreti, Life Member (LM 45) of the Nepal Geological Society and Professor of Department of Geology, Tri-Chandra Campus, Kathmandu, who has been appointed as the **Dean of Institute of Science and Technology**, Tribhuvan University, Nepal.

Dr S. M. Rai

The Nepal Geological Society congratulates Dr Santa Man Rai, Life Member (LM 202) of the Nepal Geological Society and Lecturer at the Department of Geology, Tri-Chandra Campus, Kathmandu, who has been awarded **RONAST Talent Award 2005** from Royal Nepal Academy of Science and Technology for his research on geochemical characteristics of metamorphic rocks in the Nepal Himalaya.

Dr D. P. Adhikari

The Nepal Geological Society congratulates Dr D P Adhikary, Life Member (LM 297) of NGS, on his successful completion of **Postdoctoral research on Climate Change** at Yamanashi Institute of Environmental Sciences, Yamanashi, Japan. The fellowship was awarded by Japan Society for the Promotion of Science (JSPS) in the University, Japan.

Dr L. P. Paudel

The Nepal Geological Society expresses its hearty congratulations to Dr L P Paudel, Life Member (LM 301) of NGS, on his successful completion of **Postdoctoral research** in Hokkaido University, Japan, between April 2004 and April 2006. The title of his research was **K-Ar and Ar/Ar geochemistry of Lesser Himalayan metamorphic rocks**.

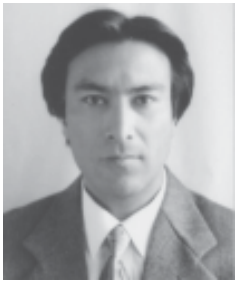
Dr P. B. Thapa

The Nepal Geological Society congratulates Dr Prem Bahadur Thapa, Life Member (LM 366) of the Nepal Geological Society, on his successful completion of Doctor of Engineering (Ph..D.) research in Civil and Structural Engineering from the Graduate School of Engineering, Kyushu University, Japan, in 2005. The title of his thesis was **GIS-based Quantitative Hazard Modelling of Landslide and Debris Flow in the Mountainous Terrain of Central Nepal**.

Dr P. D. Ulak

The Nepal Geological Society expresses its hearty congratulations to Dr Prakash Das Ulak, Life Member (LM 268) of the Nepal Geological Society, on his successful completion of the Ph. D. degree in Geology from Shimane University, Japan, 2006. The title of his thesis was **Evolution of fluvial system of Late Cenozoic Siwalik Group, Nepal Himalaya, related to tectonic uplift of Himalaya and climatic change**.

The Nepal Geological Society extends its hearty congratulations to Dr Naresh Kaji Tamrakar, Life Member (LM 306) of the Nepal Geological Society, on his successful completion of the Ph. D. degree in geology from Tribhuvan University, Kathmandu, Nepal in 2006. The title of his thesis was **Petrographic properties and their relationship with engineering properties of the Siwalik sandstones, central Nepal**.



Dr N. K. Tamrakar

Dr R. P. Bhandari

The Nepal Geological Society congratulates Dr Rajendra Prasad Bhandari, Life Member (LM 332) of the Nepal Geological Society, on his successful completion of the Ph. D. degree in Geology from Motan University, Leoben, Austria, in March 2006. The title of his thesis was **Geophysical characterisation of soil contamination –field and laboratory studies for an investigation programme in Nepal**.

The Nepal Geological Society extends its hearty congratulations to Mr. Sarvajeet Prasad Mahato, Life Member (LM 219) of the Nepal Geological Society, who has been appointed as **General Manager** of Udayapur Cement Industries Limited, Udayapur, Nepal.

Mr. S. P. Mahato

Mr. J. L. Shrestha

The Nepal Geological Society extends its hearty congratulations to Mr. Jeevan Lal Shrestha, Life Member (LM 69) of the Nepal Geological Society, who has been appointed as **Deputy Director Genera**l at the Department of Irrigation, Ministry of Water Resources, Kathmandu.

The Nepal Geological Society congratulates Mr. Siddhi Pratap Khann, Life Member (LM 117) of the Nepal Geological Society, who has been appointed as **Cheif of Groundwater Resources Development Project**, Kathmandu.

Mr. S. P. Khann

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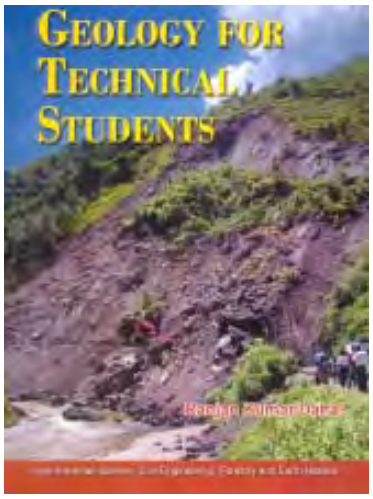

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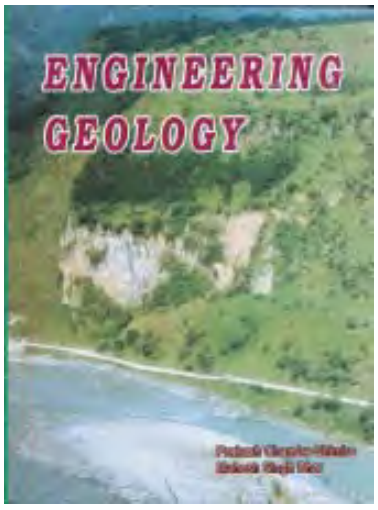

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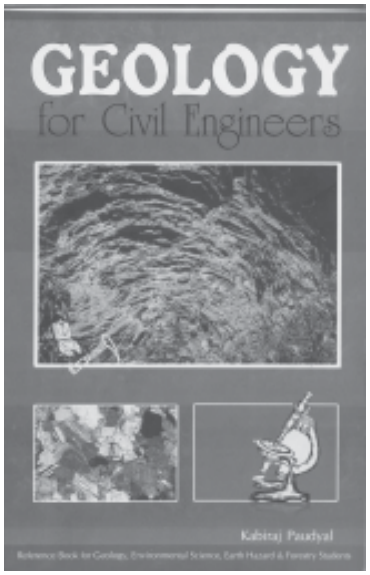

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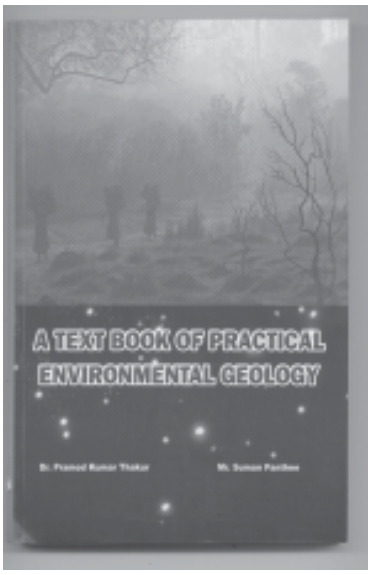

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Some Rcently Published Books

Tectonics of the Nanga Parbat Syntaxis and the Western Himalayan, edited by M. A. Khan, P. J. Treloar, M. P. Searle and M. Q. Jan. Geological Society Special Publication No. 170, 492 pages, Hardback ISBN 1–86239–061–4 Publication, March 2000. List Price US$ 150.

Mitigation and Management of Flood in Nepal - 2000 by Dr Meen B. Poudyal and Mr Damodar Bhattarai, 2001.

Application of Geographic Information Systems (GIS) for Integrated Assessment and Management of Mineral Resources in North-East Asia, Mineral Resources assessment, Development and management Series Volume 7, Published by UN/ ESCAP in 2001.

Integrated Assessment and Development of Mineral Resources in the Great Mekong Subregion, Vol. II/ ESCAP 1999. Mineral concentrations and hydrocarbon accumulations in the ESCAP Region.

Structural Geology: **A practical guide to surface and subsurface map interpretation** (Textbook) by R. H. Groshong, Springer, 1999, 320 pp. ISBN 3540654224.

Analytical Solutions of Geohydrological Problems by G. A. Bruggeman. Elsvier, 1999, 970 pp, ISBN 0444818294. Price US$ 465.00.

Cambridge guides to minerals, rocks and fossils by A. Woolley et al. Cambridge University Press, 1999. 336 pp. ISBN 0521778816, Price US$ 465.00.

Earth Science and Environment (2nd edition) by Graham R. Thompson, Saunders College Publishing 1999, ISBN 0030060486.

Earthquake Geotechnical Engineering (Proceedings of the 2nd International Conference, Lisbon, Portugal, 21-25 June 1999, 3 volumes) by P. Secoe Pinto, A. A. Balkema, 1100 pp. ISBN 0444818294, Price US$ 215.00.

Environmental Assessment Practice Guide by Barbara Carol and Trevor Turpin. Thomas Telford Ltd. 1999, 150 pp., ISBN 0727727818, Price UKL 20.00.

Flood and Landslide: Integrated Risk Assessment (Environmental Science) edited by R. Casale and C. Margottini. Springer, 1999, 320 pp., hardback, ISBN 3540649816, Price UKL 96.00.

Geostatistics in Petroleum Geology by Oliver Du Burle, Continuing Education Course Notes #38, Cat. #908, The American Association of Petroleum Geologists, 1998, ISBN 0891811877, Member Price US$ 24.00; List price US$ 30.00.

Geostatistics for Engineers and Earth Scientists by R. A. Olea. Kluwer 1999, 328 pp., ISBN 0792385233.

Geostatistics for Environmental Scientists by R. Webster and M. A. Oliver, John Wiley, 1999. 442 pp., ISBN 0471965537, Price US$ 76.50.

Geotechnical Engineering: Principals and Practices by Donald P. Coduto, Prentice Hall 1999, 750 pp., hardback, ISBN 0444818294, Price US$ 110.00.

Groundwater pollution control edited by K.L. Katsifarakis, WIT Press, 1999, ISBN 1853126756, Price UKL 112.00.

Hydrogeology and Engineering Geology of Sinkholes and Karst (Proceedings of the 7th Multidisciplinary Conference on Harrisbug Hershey, PA. USA. 10-14 April 1999) edited by Barry F. Beck et al., A.A. Balkema, 1999, 480 pp., hardback, ISBN 9058090469, Price US$ 115.00.

On the determination of sediment accumulation rates (Georesearch Forum, Vol. 5) edited by P. Bruns and H.C. Hass, Trans Tech Publications Ltd., 1999, 256 pp., ISBN 0878498370, Price UKL 58.00.

Slope Stability by Anderson. John Wiley 1999. ISBN 084934106.

Soil Mechanics and Geotechnical Engineering (Proceedings of 11th Asian Regional Conference, Seoul, Korea, 16-18 Aug. 1999) edited by Sung-Wan Hong, A.A. Balkema 1999,. Two vols. 900 pp. Price US$ 85.00.

Soil Mechanics and Geotechnical Engineering (Proceedings of 12th African Regional Conference, Durban, 25-27 Oct 1999) edited by Peter Day. A. A. Balkema, 1999, Vol. 3, 1200 pp., ISBN 9058090825, Price US$ 152.00.

Mineralogy Tutorials, Interactive instruction on CD-ROM Version 2.0 by C. K. Lein., John Wiley 1998, Price US$ 49.95.

Engineering and General Geology, 2005, S. K. Kataria & Sons, 580 pp., Price IC 195.00.

Paryawaran Monthly, Vol 63, 2006, Vatawaran Tatha Bal Sarokar Snastha Nepal *(In Nepali).*

Recent Journals of NGS

Journal of Nepal Geological Society, Volume 32 (Special Issue), September 2005 (Abstracts of 5th Asian Regional Coference on Engineering Geology for major infrastructure development and natural hazards mitigation held on 28-30 September 2005 in Kathmandu, Nepal)

Journal of Nepal Geological Society, Volume 31, June 2005

Journal of Nepal Geological Society, Volume 30 (Special Issue), December 2004 (Proceedings of 4th Nepal Geological Congress held on 9-11 April 2004 in Kathmandu, Nepal)

Journal of Nepal Geological Society, Volume 29, June 2004

Journal of Nepal Geological Society, Volume 28, June 2003

Journal of Nepal Geological Society, Volume 27 (Special Issue), September 2002 (Proceedings of 3rd Nepal Geological Congress held on 26-28 Sept 2002 in Kathmandu, Nepal)

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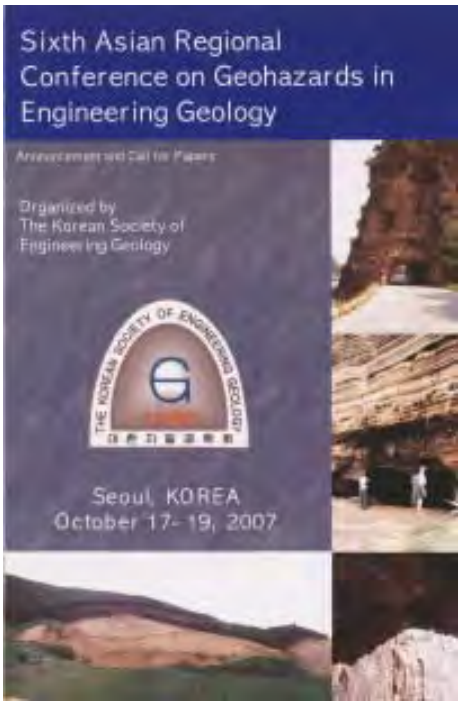

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NEW MEMBERS OF NEPAL GEOLOGICAL SOCIETY

Membership No	Name	Address
LM -532	Sujan Raj Adhikari	141, Mahadevsthan Marg-1, Ward No. 10, Baneswor, Kathmandu, Nepal Tel: 01-4473452 (R.), Email: asujan@gmail.com
LM -533	Paresh Raj Pandey	Central Department of Geology, Kirtipur, Kathmandu, Nepal, Tel: 01-4332449(O.) Mailing address: PO Box: 21992, Kathmandu, Nepal, Tel: 016204121 (R.) Email: pandeyparesh@yahoo.com
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M -536	Mahesh Pokhrel	Tri-Chandra Multiple Campus, Ghantaghar, Kathmandu, Nepal, Tel: 01-4268034 (O Mailing address: PO Box: 23838, Kathmandu, Nepal, Tel: 01-4333729 (R.) Email: maheshpokhrel@hotmail.com
LM -537	Kuwar Deep Srivastava	Raipur VDC-7, Surawha, Rupendehi, Nepal Mailing Address: PO Box: 23838, Kathmandu, Nepal, Tel: 01-2020276 (R.) Email: mail_cutekuwar_2005@hotmail.com
LM -538	Dev Krishna Maharjan	Kirtipur Municipality-1, Galche Tol, Kirtipur, Kathmandu, Nepal Tel: 01-4335026 (R.), Email: dkmaharjan@yahoo.com
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LM -540	Rajesh Dhungana	Central Department of Geology, Kirtipur, Kathmandu, Nepal, Tel: 01-4332449(O.) 01-4450198 (R.), Email: raj_dhungana2004@yahoo.com
LM -541	Ravindra Prasad Dhakal	41-Suryodaya Galli-1, Battisputali, Kathmandu, Nepal, Tel: 01-4475314 (R.) Email: rabidhakal@gmail.com
LM -542	Aarati Chanda Pradhan	Post Box: 4159. Kathmandu, Nepal, Tel: 01-5526404 (R.) Email: aaratichanda@hotmail.com
Associate Member	Jagadish Chudal	Himali Ratna Udyog Pvt. Ltd, Kathmandu, Nepal, Tel: 01-2172889 Email: jpchudal@yahoo.com

Note: LM- Life Member; M- Member; AM-Associate Member

OBITUARY

15/06/2023 BS – 25/12/2062 BS

Late Dr Pramod Kumar Thakur

Life Member of NGS: LM-339

Date of Birth: 15/06/2023 BS

Place of Birth: Janakpur, Nepal

Education:

Ph. D. (Geology) in 2001 from Tribhuvan University, Kathamandu, Nepal (***First Ph. D. in Geology from T. U.***)

Masters in Science (Geology) in 1991 from Ranchi University, Ranchi, India

Bachelor in Science (Honours, Geology) in 1989 from Ranchi University, Ranchi, India

Training:

International Training Course on Remote Sensing Education for Educator, organised by the United Nations and the Government of Sweden, 1998

Profession: Geologist

Services: Lecturer, Central Department of Geology, Tribhuvan University (1994-2006)

Award: Mahendra Vidya Bhushan "Ka"

Research activities:

Principal Investigator of the project entitled "Development of Environmental Engineering Preventive Measures for Flood Control in the Sapta Koshi Alluvial Fan, Eastern Nepal", sponsored by the Royal Nepal Academy of Science and Technology (RONAST) and the Central Department of Geology, Tribhuvan University, from 2000 to 2001.

Investigator of the project entitled "Holocene Morphostratigraphy of the Melamchi Khola Watershed, Central Nepal, sponsored by JICA and Central Department of Geology, Tribhuvan University, 1999 to 2000.

Research Assistant of the project entitled "National Climate Change Study Project", DHM/HMG Nepal and the Central Department of Hydrology and Meteorology, 2001 to 2002.

Publications:

Pramod Kumar Thakur and Suman Panthee ***: A Text Book of Practical Environmental Geology***. New Hira Books Enterprises, Kathmandu, 2004.

P. K. Thakur and P. C. Adhikary: ***Geomorphology of the Arun valley, eastern Nepal***. Jour. Nepal Geol. Soc. Department of Irrigation, v. 23, 2001, pp. 37-46.

P. K. Thakur and N. K. Tamrakar: ***Geomorphology, sedimentology, and hazard assessment of the alluvial fan in eastern Nepal***. Jour. Nepal Geol. Soc. v. 27 (Sp. Issue), 2002, pp. 39-51.

P. K. Thakur: ***Morhometric analysis of Arun valley, eastern Nepal***. Jour. Nepal Geol. Soc. v. 28, 2003, pp. 133-140.

P. K. Thakur and N. K. Tamrakar: ***Natural and anthropogenic factors of flooding in the Saptakoshi alluvial fan, east Nepal***. Jour. Nepal Geol. Soc. v. 30 (Sp. Issue), 2004, pp. 157-166.

Holocene Morphostratigraphy of the Melamchi Khola Watershed in the north of Kathmandu Valley, Central Nepal

Geomorphological Classification and Environmental Management of the Karnali Fan, Western Nepal

Environmental Management and Associated Problems in the Higher Himalayan Region, a Case Study, Eastern Nepal

OBITUARY

14/12/1931 AD – 1/01/2006 AD

Late Dr. Gudrun Corvinus

Life Member of NGS: LM-119

Date of Birth: 14 -12-1931 AD

Place of Birth: Germany

Profession: Palaeontologist

Education:

Ph.D. in palaeontology from University of Tubingen, Germany

Graduated in geology, palaeontology and prehistory from University of Tubingen, Germany

Honorary Member: German Archaeological Society

Major Contributions:

Dr Corvinus was a German Geo-Archaeologist. When she was a member of the Afar Expedition in Ethiopia had discovered the famous skeleton called "Lucy". Similarly, she had discovered Miocene animal fossils while working in the Nabibion desert.

Corvinus had come to Nepal in 1984. She carried out the research works on palaeontology extensively in the Siwaliks of the Nepal Himalaya, specially in the Dang and Deokhuri valleys.

She was affiliated to the Nepal Research Centre, Kathmandu, Nepal and Institute for Prehistory, Erlangen University, German Research Foundation/German Research Council (DFG).

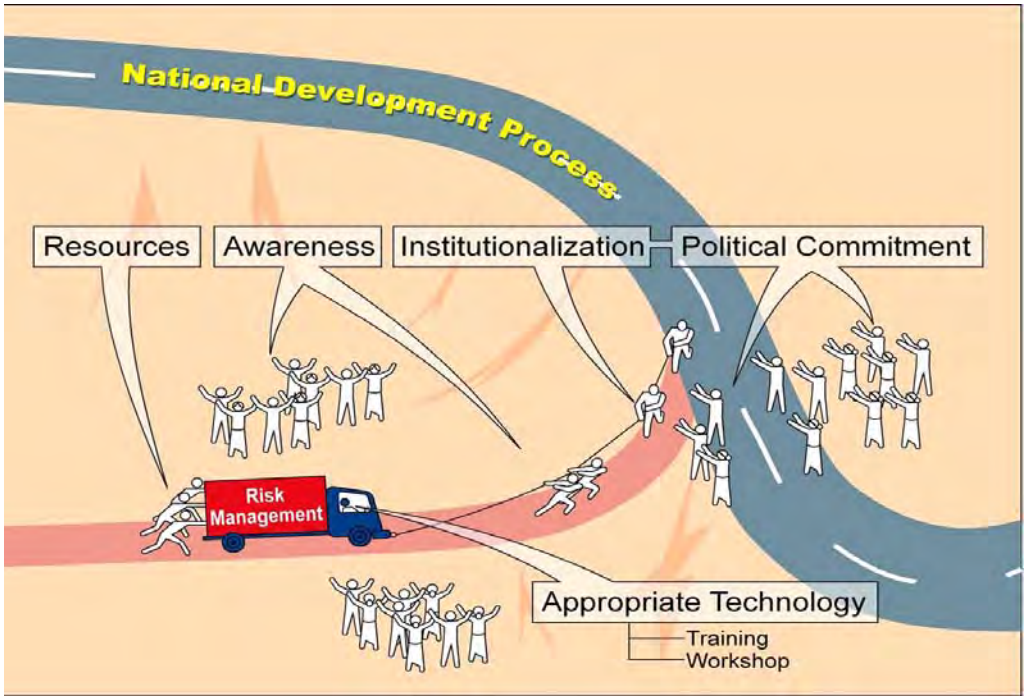
Publications:

1981: A Survey of the Pravara River System in Western Maharastra, India (Volume 1: The Stratigraphy and Geomorphology of the Pravara River System)

1983: A Survey of the Pravara River System in Western Maharastra, India (Volume 2: The Excavations of the Acheulian Site of Chirki-on-Pravara, India

"The Prehistoric cultures in Nepal from the early Paleolithic to the Neolithic". In two volumes in volumes in press.

More than a dozen of publications on palaeontological researches in Siwaliks of the Nepal Himalaya.
More than a dozen of publications on prehistoric discoveries from the foothills of the Nepal Himalaya.



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NSET aims to assist all communities in Nepal to become safer against earthquake by 2020 AD by developing and implementing organized approaches to managing earthquake risk.

We understand that this challenge can be achieved only through partnership between communities and institutions.

NSET

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Published by: Nepal Geological Society,
PO Box 231, Kathmandu, Nepal
E-mail: info@ngs.org.np
Website: http://www.ngs.org.np